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WAR FOOD ADMINISTRATION
Office of Distribution
5 South Wabash Avenue
Chicago 3, Illinois

April 7, 1944

Mr. E. O. Pollock, Director
Midwest Region
Office of Distribution

Dear Mr. Pollock:

Herewith is submitted the report entitled, "How To Obtain More Nonfat Dry Milk Solids". The information presented and the conclusions and program recommendations arrived at are highly important, not only in the light of war food needs, but also with reference to the planning of postwar adjustments in food production and consumption.

The report summarizes the rapid growth of the industry in prewar years, reviews its wartime expansion in 1941 and 1942, points out the reasons for the downturn in production in 1943, and outlines the measures necessary to bring up the annual production to a level of approximately 850 million pounds per year. The section dealing with the postwar outlook for nonfat dry milk solids will be of particular interest to many persons in the dairy industry and to industries using this commodity.

Data of production and prices of nonfat dry milk solids and related products, together with data of milk production and disposition, are presented in appendix tables for the convenience of persons interested in this subject. In addition, the average number of cows milked per farm, total milk production, and sales of butterfat from herds of four or more cows, are shown by counties for seven states of the Midwest Region.

It is hoped that this report will represent a definite contribution to the nationwide effort being made to increase the output of this much needed food. The information provided is designed to support the position of the Dairy and Poultry Branch in its current endeavors to promote a better utilization of the available milk supply.

Respectfully yours,

Rudolph E. Patzig
Rudolph E. Patzig, Chief
Program Appraisal Division

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WAR FOOD ADMINISTRATION
OFFICE OF DISTRIBUTION
PROGRAM APPRAISAL DIVISION
MIDWEST REGION

HOW TO OBTAIN MORE NONFAT DRY MILK SOLIDS
Background of the Industry, Its Status, and Outlook

by

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Senior Agricultural Economist

Chicago, Illinois
April, 1944

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F O R E W A R D

The production of nonfat dry milk solids -- a food urgently needed in our war food program -- has consistently fallen short of requirements. In spite of the erection of new drying plants, the conversion of feed dryers into plants for the production of human food, and other measures designed to increase the wartime output of this commodity, production actually decreased in 1943. By May of that year, the supply fell so far short of the demand that it became necessary to order that 75 percent of the output of all important dryers should be reserved for military and Lend-Lease purposes, thus cutting domestic consumption down sharply in the face of increased needs.

In view of the lack of success met by previous efforts to increase the production of this commodity, it was apparent that a thorough investigation would be required to ascertain the reasons for the decrease in production and to point out the measures essential to a substantial increase. This indication was confirmed by a preliminary survey of the problem, which revealed that the production of nonfat dry milk solids was intimately related both to the whole dairy situation and to the shortage of high protein feeds. With the approval of the Regional Director, a comprehensive investigation of the problem was begun in the fall of 1943.

In order to expedite the preparation of a report, the subject matter of the investigation was restricted to a consideration of the steps which must be taken to obtain a substantial increase in the production of nonfat dry milk solids for human food. Emphasis was placed upon the measures essential in establishing conditions which would permit such an increase; questions as to which plants or localities should be included were left for subsequent determination.

The report was read in manuscript form by Dr. E. W. Gaumnitz and Mr. Roud McCann, whose suggestions are much appreciated. Professor E. Fred Koller of the University of Minnesota made available a manuscript copy of his Bulletin, "The Minnesota Dry Milk Industry" and together with Professors W. H. Dankers and W. B. Combs, provided other helpful information. Valuable suggestions were made by Dr. Frederick V. Waugh of the Office of Distribution. Special acknowledgments are due to Dr. W. H. Ebling and Mr. S. J. Gilbert of the Wisconsin Crop and Livestock Service, to Messrs. B. H. Bennett and W. D. Bormuth of the Bureau of Agricultural Economics, Burton G. Wood of the Office of Distribution, J. M. Jensen of Michigan State College, and Professors Asher Hobson, P. E. McMill R. K. Froker, and C. M. Hardin of the University of Wisconsin, A. W. Rudnick of Iowa State College, and H. P. Davis of the University of Nebraska.

TABLE OF CONTENTS

	<u>Page</u>
Summary.....	1
Development of the dry milk industry in the United States.	3
Description of manufacture.....	5
Production increased rapidly after World War I.....	6
Drying capacity is much in excess of production.....	8
Prices of nonfat dry milk solids (for human food).....	8
Nonfat dry milk solids is an exceptionally valuable food..	10
Uses of nonfat dry milk solids in human diets in the United States.....	11
The need for nonfat dry milk solids has far outrun the supply.....	12
Repeated attempts to increase production were made.....	12
Reasons for downturn in production in 1943.....	13
Set-aside orders became necessary late in 1942.....	15
Vigorous action should be taken to increase the output....	17
Leading authorities urge an increased supply.....	17
Protein may be in scant supply.....	18
Possibility of short crop emphasizes need for increase.	19
Increase must come mainly from skim milk now fed.....	20
Increase will require only minor portion of skim milk now fed.....	20
Some factors affecting procurement of skim milk.....	21
Feeding demand for skim milk is variable.....	31
Additional facilities will be needed.....	32
Additional inducements will be required to attract requisite quantity.....	34
Annual output of 850,000,000 pounds is practicable.....	36
Increase will be acceleration of trend.....	36
Domestic requirements can absorb increased output.....	37
Tentative estimates of postwar utilization.....	40
Costs of program may be comparatively small.....	41
A broad, coordinated program is essential in obtaining in- crease.....	43
Assurance of a market for nonfat dry milk solids.....	44
A premium on whole milk delivery.....	44
Government funds should be employed.....	45
A publicity campaign.....	45
Educational work in animal nutrition.....	46
Price control of other manufactured dairy products.....	46
Aid in labor matters.....	47
More intensive use of drying equipment.....	47
Decentralization of purchasing and shipping arrangements	49
A quality improvement program.....	49
Most of new drying equipment should be of roller type.....	51
Roller equipment is better suited to many new localities	51
More roller powder can be used advantageously.....	53

C H A R T S

<u>Figure</u>		<u>Page</u>
1.	Milk produced per square mile, by counties, in the Great Lakes Region.....	23
2.	Gallons of milk produced per square mile in 1939, by counties, in Minnesota and Iowa - Total for all cows milked.....	24
3.	Butterfat sales per square mile in 1939 from herds of 4 or more cows, by counties, in the Great Lakes Region.....	25
4.	Butterfat sales per square mile in 1939 from herds of more than 3 cows, by counties, in Minnesota and Iowa.....	26
5.	Average number of cows milked per farm, by counties, in the Great Lakes Region in 1939.	29
6.	Average number of cows milked per farm, by counties, in Minnesota and Iowa in 1939.....	30

APPENDIX TABLES

	<u>Table Number</u>
Total supply and utilization of milk in the United States in selected years.....	1
Milk: Production on farms, milk equivalent of farm churnings and sales of butterfat, and deliveries to wholesale plants, by years, United States, 1924-42...	2
Milk: Production on farms in the Midwest Region, by States, 1935-42.....	3
Cream sales and whole milk deliveries to wholesale plants in the Midwest Region, by States, 1935-42.....	4
Nonfat dry milk solids for human food: Production, by months, United States, 1935-43; Average 1935-39...	5
Nonfat dry milk solids for animal feed: Production, by months, United States, 1935-43; Average 1935-39...	6
Dried whole milk: Production, by months, United States, 1935-43; Average 1935-39.....	7
Casein, dried: Production, by months, United States, 1935-43; Average 1935-39.....	8
Creamery butter (including whey butter): Production, by months, United States, 1935-43; Average 1935-39...	9
Cheese, whole milk, American Cheddar: Production in factories, by months, United States, 1935-43; Average 1935-39.....	10
Milk, evaporated, unsweetened, unskimmed, case goods: Production, by months, United States, 1935-43; Average 1935-39.....	11
Dried whole milk and nonfat dry milk solids for human consumption: Production, by States, 1942.....	12
Creamery butter (including whey butter): Production in the Midwest Region, by States, in selected years..	13
Malted milk powder: Production in United States, 1916-42.....	14
Dried buttermilk: Production in United States, 1916-43.....	15

Table
Number

Nonfat dry milk solids for human food: Average manufacturers' selling price, f.o.b. factory, by months, United States, 1935-43; Average 1935-39..	16
Dried whole milk: Average manufacturers' selling price, by months, United States, 1935-43; Average 1935-39.....	17
Casein, domestic: Average wholesale price, by months, New York, 1935-43; Average 1935-39.....	18
Butter, 92-score creamery: Wholesale price, by months, Chicago, 1935-43; Average 1935-39.....	19
Cheese, American Twins or Cheddars: Wholesale price on the Wisconsin Cheese Exchange, by months 1935-43; Average 1935-39.....	20
Milk, evaporated, unsweetened: Average manufacturers' selling price of 48 14 1/2-ounce cans, f.o.b. factory, by months, 1935-43; Average 1935-39.....	21
Illinois: Milk produced by all cows on farms and sales of butterfat from herds of four or more cows per square mile, by counties, 1939.....	22
Indiana: Milk produced by all cows on farms and sales of butterfat from herds of four or more cows per square mile, by counties, 1939.....	23
Iowa: Milk produced by all cows on farms and sales of butterfat from herds of four or more cows per square mile, by counties, 1939.....	24
Michigan: Milk produced by all cows on farms and sales of butterfat from herds of four or more cows per square mile, by counties, 1939.....	25
Minnesota: Milk produced by all cows on farms and sales of butterfat from herds of four or more cows per square mile, by counties, 1939.....	26
Ohio: Milk produced by all cows on farms and sales of butterfat from herds of four or more cows per square mile, by counties, 1939.....	27
Wisconsin: Milk produced by all cows on farms and sales of butterfat from herds of four or more cows per square mile, by counties, 1939.....	28

SUMMARY

1. Steps should be taken promptly to increase the production of nonfat dry milk solids by at least 400,000,000 pounds per year, bringing the annual output up to about 850,000,000 pounds. Need for this commodity is so urgent that many domestic requirements will have to remain unfilled in 1944 in order to provide for military, Lend-Lease, and rehabilitation necessities. The proposed expansion is the only available source of a significant increase in the supply of animal protein and other needed nutrients at a time when the need for nourishing foods may be increased by the requirements of underfed peoples about to be liberated. Prompt action is necessary because the need may reach its peak in 1945.
2. The proposed increase will represent only a further acceleration of the longtime upward trend in the production of nonfat dry milk solids. Production and consumption in the United States were increasing rapidly before the war, practically doubling from 1935 through 1941, and many new uses were being discovered. Because of the high nutritive value and comparatively low price of this commodity, there is reason to believe that domestic consumption will gain rapidly when supplies again are adequate, even though it has been cut down at present by war exigencies. With a moderate amount of governmental aid after the end of the rehabilitation period to make up for this dislocation, it is probable that domestic consumption will be fully equal to the suggested production in a few years from that time.
3. Nonfat dry milk solids is an exceptionally valuable food. It contains a large proportion of protein which is equalled only by egg protein and is definitely superior to most other proteins. It provides a large quantity of lactose, or milk sugar, which is highly digestible, and it carries comparatively large proportions of calcium, phosphorus, and a number of needed vitamins, including riboflavin, which is deficient in many diets. Nonfat dry milk solids is especially valuable as a supplement to diets consisting principally of vegetable foods.
4. Nonfat dry milk solids is highly economical. Its cost per pound is only a fraction of that of powdered eggs and is materially lower than that of the solids other than fat in either cheese or evaporated milk. This low cost is largely explained by the fact that it still is a byproduct of butter and fluid cream, with the result that the major cost of the milk involved is assumed by the other products.
5. The increased output of nonfat dry milk solids can be obtained at a moderate cost. More than six times as much skim milk as is required for the proposed increase is now fed to animals on farms. The requisite quantity can be obtained, perhaps with no increase over present inducements, by assuring the farmers

and creameries involved of a continued market for the product and providing at government expense the necessary facilities in localities where they are needed but are not available.

6. Fear that they will be unable to dispose of their output of nonfat dry milk solids after the end of the rehabilitation period is the principal reason deterring many creameries from entering upon its manufacture. This possibility is a major risk to each of them, the more so since those who are among the last to enter this field may well be among the first to be crowded out of it if demand slackens. By providing a continued market for this product for several years after the close of the rehabilitation period, the government can, in effect, pool these risks and can assume them much more economically than can the individual creameries.
7. Use of government funds in providing drying facilities in appropriate localities will expedite the increase in production and will reduce the total of other inducements which must be offered to obtain a given increase. Government funds already have been used in the erection of plants and the purchase of equipment for milk drying and this practice may well be extended to the provision of all the facilities involved, including milk cooling equipment on farms shifting from farm separation to whole milk delivery.
8. For most effective results, a definite goal should be set and announced publicly and the measures adopted to achieve it should be coordinated into a broad program. Two important steps toward increased production already have been taken. The War Food Administration, through Food Distribution Order No. 93, has moved to end the diversion of milk from nonfat dry milk solids and butter to roller process dried whole milk, 12 percent fat dried milk, and similar products. The Office of Price Administration has advanced the ceiling price on roller process nonfat dry milk solids to 14 cents per pound, narrowing the discount under spray process powder to only half a cent per pound. The higher price level for roller process powder will encourage a shift from farm separation to whole milk delivery in numerous localities where formerly the feeding demand for skim milk overbalanced the returns from drying by the roller process.
9. Additional measures in a broad program designed to obtain an increase of 400,000,000 pounds of nonfat dry milk solids should include:
 - A. Assurance of a continued market.
 - B. Publicity to bring out clearly the need for this food.
 - C. Education concerning feeding substitutes for skim milk.
 - D. Specific price ceilings upon competing dairy products.
 - E. Quality improvement program.
 - F. More intensive use of existing drying equipment.
 - G. Decentralized purchasing and storing arrangements.

HOW TO OBTAIN MORE NONFAT DRY MILK SOLIDS
Background of the Industry, Its Status, and Outlook

- - -

DEVELOPMENT OF THE DRY MILK INDUSTRY IN THE UNITED STATES

In contrast to butter-making and cheese manufacture, which trace back to ancient times, the drying of milk is a recently discovered process. True, Marco Polo reported that the Mongols used dried mares' milk ⁽²⁾ in a doughlike form which they obtained by placing the milk in shallow depressions in rocks. Probably the drying was favored by climatic conditions. No general use of dried milk has been reported until recent times.

With the exception of the milk consumed as fluid milk and used in the manufacture of cheese, the milk fat or butterfat was long the only portion of the milk nutrients entering directly into commerce as a food. In contrast to the fat which could be separated readily from the remainder of the milk, churned into butter, and preserved by salting, or later by cold storage, the milk solids other than fat were difficult to concentrate and preserve in an acceptable form. Because they had to be used promptly to avoid spoilage, they commonly were fed to animals on farms.

The situation was much like that which prevailed in the cattle industry in California a hundred years ago. Largely because of the difficulty of preserving the meat, the animals were slaughtered for their hides and tallow, which were the only parts having a commercial value. The meat, which now is much more valuable, was left to rot or to be eaten by wild animals.

Observant farmers, noting the high value of the skim milk as a supplement to corn and other carbohydrates, planned their operations with an eye to its efficient use, but part of it frequently went to waste in some sections where dairying was intensive. In many instances, also, its value was comparatively low because a number of farms had large quantities of skim milk for feed in proportion to the number of animals consuming it.

In the present century, and particularly within the past two decades, research in human nutrition has emphasized the value of the solids-not-fat in milk, as well as milk fat, and increasing attention has been given to the importance of these nutrients in human diets. Few people realize that the nonfat solids constitute approximately two-thirds of the total milk solids, but on an average, milk containing 4 percent of butterfat contains also 8.67 percent of solids-not-fat. ⁽⁵⁾ From a nutritional standpoint,

the nonfat solids are of greater value than the butterfat, even though the butterfat is the most valuable fat known.

The first mention of dried milk in Europe is found in 1810 when Nicholas Appert produced dried milk tablets. (2) Then a patent was issued to a Mr. Birdseye in 1850; and in 1855, a British patent was issued; another in 1866; and up to about 1890, various other patents were issued for various processes of milk drying. In general these processes involved the addition of sugar, starch, soda, or other substances to the milk and were unsatisfactory for commercial use.

It is noticeable that the earlier attempts antedated the manufacture of condensed and evaporated milk. Gail Borden first produced and marketed unsweetened condensed milk in 1856 and John B. Meyenberg first produced unsweetened evaporated milk commercially in 1885. (2) The production of both these commodities, however, became of wide importance commercially while milk drying was in its early stages.

"Malted milk, which is a form of dried milk, was first marketed in 1887 -- the process having been invented in 1883. Dried milk without mixture of foreign ingredients as it is known today was not produced in the United States until 1898. The first roller process of drying milk which was widely used was invented in 1902 and the first application of spray drying of liquids to the milk industry was made in 1901 by Robert Stauff of Posen, Germany." (19)

About the beginning of the present century, a number of efforts to develop new milk drying processes were made in the United States, principally in New York State and Vermont. About 1902-03, some skim milk was being dried at Cherry Valley and Adams, New York, using processes now obsolete. Then in 1906, the first spray drying of skim milk was begun on a commercial scale at Arcade, New York. In California, the first spray process plant was built at Ferndale, about 1910. Various improvements in processes continued to be made and additional plants were erected. Production for some time was concentrated in New York and California. (2) In New York, the developments arose principally from a desire to find a profitable market for the skim milk which remained from the production of fluid cream; in California, the skim milk was left from the manufacture of butter in whole milk creameries. Production was principally of nonfat dry milk solids for human food.

About 1927, the production of nonfat dry milk solids for feed, largely in roller process plants, began to increase materially.

This increase was pronounced in certain areas of the Middle West. Part of the demand for such powder arose from the desire of the better established milk plants for a high quality feed for sale to their patrons. By distributing feed quality nonfat dry milk solids to their patrons, the established plants encouraged their patrons to deliver a larger proportion of the total milk production in their respective areas. Prices were comparatively low for animal feed and production was in competition for skim milk with another recently developed by-product of the dairy industry, the production of casein for industrial uses.

Many of the midwestern creameries began drying operations in buttermilk; then began to dry some skim milk for feed, and presently turned to the production of nonfat dry milk solids for human food. Only a very small proportion of the roller process nonfat dry milk solids (exclusive of the vacuum drum process) was taken for food at first, but the percentage increased gradually and about 30 percent of the total output of nonfat dry milk solids for food before the outbreak of the war consisted of roller process powder.

Description of Manufacture (12)

Two main types of processes are employed in the powdering of milk, the spray process and the roller process. These processes are quite different in principle. In the spray process, the milk is dried by being sprayed into a chamber containing heated air; in the roller process, a film of milk is deposited upon revolving heated rollers.

In the spray process, the spraying is effected either by forcing the milk under very high pressure through small orifices in spray nozzles or by permitting it to trickle onto a disc revolving at high speed, with the result that the milk is atomized by centrifugal force. In either process, the milk particles are reduced to a fine mist and on contact with the heated air, they are dried quickly and are deposited on the bottom and sides of the drying chamber.

In the roller process, the milk is dried as a film upon a heated, revolving drum. The milk is applied to the drum in the form of a thin film, and the dried film is subsequently removed by means of a knife or scraper. The roller process dryers are of two types, those in which the drying is done at atmospheric pressure and those in which the drying is accomplished in a partial vacuum.

Comparatively few vacuum drum rollers are in operation and most of the roller process nonfat dry milk solids produced in the United States is of the atmospheric type.

In the vacuum drum type of roller process, operations are conducted in a vacuum chamber, taking advantage of the fact that drying can

then be effected at lower temperatures because evaporation takes place more rapidly. Commonly, the construction is of the single drum type. The milk may be sprayed upon the revolving drum or may be applied to the drum in a variety of ways and when dried, is removed from the drum by a scraper which causes the dried milk to fall into a conveyor. The dried milk removed from the rollers in all types of the roller process is primarily in the form of flakes which must be ground into powder of the requisite fineness.

In the atmospheric roller process, either a single drum or double opposing drums may be employed. If a single drum is used, the milk usually is precondensed before drying because liquid milk is too thin to provide a satisfactory thickness of film. In some types of construction, the drum revolves in a reservoir of precondensed milk, picking up a thin film; in some others, the milk is applied to the main drum by a smaller drum which revolves in the reservoir. In still another type, the milk is sprayed upon the drum. In the double drum construction, two opposing drums are set about 0.02 of an inch apart, acting as a reservoir for the milk, which is fed between them by a pipe placed above them. The drums revolve toward each other, picking up a thin film of milk, which is dried and adheres to the drums until it reaches the scraper on each drum which removes the film, causing it to fall into conveyors.

In addition, some skim milk is dried by the "flake" method, in which the milk is concentrated to a batter-like consistency, treated with air under pressure to render it full of bubbles and more viscous, and then fed to a carrier in the form of a woven wire belt which passes the product into a drying chamber where heated air is applied to both sides of the layer on the belt. (2) The product is packed in the form of flakes.

Production Increased Rapidly After World War I

Although data of nonfat dry milk solids production in the United States go back to 1916, the principal increase occurred after 1919. The annual output grew from less than 42,000,000 pounds in 1920 to more than 400,000,000 pounds in 1940. These figures are for food and feed combined. Until about 1927, nearly all the output consisted of milk dried for human food. In 1927, the drying of skim milk for animal feed began to increase materially and continued to gain in volume until sometime in 1942. ^{1/} The annual

^{1/} Information received from Roud McCann, Director, The American Dry Milk Institute, Inc.

data are:

<u>Year</u>	<u>Production</u> (1,000 lbs.)	<u>Year</u>	<u>Production</u> (1,000 lbs.)
1916	16,463	1930	255,432
1917	22,624	1931	261,938
1918	26,202	1932	270,276
1919	34,945	1933	288,114
1920	41,893	1934	294,935
1921	38,546	1935	297,505
1922	40,617	1936	349,551
1923	62,251	1937	372,203
1924	69,219	1938	449,291
1925	73,317	1939	408,380
1926	91,718	1940	481,805
1927	118,123	1941	476,497
1928	147,996	1942	626,280
1929	207,579	1943	477,881

Beginning with 1935, the quantity of nonfat dry milk solids produced for human food in the United States was reported separately from that manufactured for feed. By that year, the production for food aggregated nearly 190,000,000 pounds, or 63 percent of the total output. Production for human food gained rapidly, amounting to 322,000,000 pounds in 1940 before the impact of war demands. Then it jumped to 565,000,000 pounds in 1942, but fell off sharply in 1943. Annual data, beginning with 1935, of the production of nonfat dry milk solids for food are:

<u>Year</u>	<u>Production</u> (1,000 pounds)
1935	187,531
1936	223,827
1937	244,511
1938	289,121
1939	267,360
1940	321,843
1941	365,984
1942	565,256
1943	453,757

Approximately 60 percent of the skim milk dried for food in the United States originated in the Middle West in 1942, with Wisconsin leading all other States by a considerable margin. Most of the remaining 40 percent is divided between two widely separated areas which include New York, Vermont, and Pennsylvania in the Northeast, and the Pacific Coast States and Idaho in the West.

It should be borne in mind, however, that under the pressure of war demands, the geographic distribution of nonfat dry milk solids

output is shifting rapidly. Increased consumption of fluid milk has cut down the quantities of skim milk available for drying in the Northeast and in a number of areas along the Pacific Coast, as well as in other places scattered throughout the United States. Production is tending to increase in areas of comparatively heavy milk production where the skim milk formerly was fed to animals.

Drying Capacity is Much in Excess of Production

It appears that the drying capacity of spray process and roller process plants, combined, in the United States, would permit an annual output of nonfat dry milk solids nearly three times as great as that of 1943, provided that adequate supplies of milk are available for drying and that other factors are favorable. This makes allowance for seasonal variations in the supply of milk. On the basis of peak capacity, the annual output could be much larger. 2/

A study of drying capacity, based on the equipment on hand January 1, 1943, indicated that, allowing for seasonal variations in the milk supply, more than 1,200,000,000 pounds of skim milk could be dried yearly in the United States, provided that other conditions were favorable. Since that date there has been a further increase in drying capacity, principally in Wisconsin and Minnesota.

Even in June, which is the month of heaviest milk production, the output of nonfat dry milk solids in that month of 1942 was far below capacity although, doubtless, many plants were producing at or close to their respective capacities. It was noticeable that the ratio of production to capacity was higher generally in the spray process than in the roller process plants. The difference between capacity and output was even more pronounced in June, 1943.

Prices of Nonfat Dry Milk Solids (for Human Food)

Trade reports indicate that during World War I and for some time thereafter, spray process nonfat dry milk solids commanded approximately 25 cents per pound, with one lot selling for export at 32 cents per pound. Prices did not drop below 10 cents per pound until late in the 1920's.

Compilation of monthly average prices of nonfat dry milk solids for human food was begun by the United States Department of Agriculture in 1935. From January, 1935 to December, 1940, the price of nonfat dry milk solids for human food ranged from 4.70 cents per pound in April, 1939, to 9.62 cents in November, 1936. The low price came

2/ The reasons for the comparatively small output will be discussed below, pp. 13-15.

at a time when prices of all manufactured dairy products generally were depressed by the unusually heavy flow of milk in 1938 and the large carryovers of butter and other products. Prices advanced rapidly during 1941 and the highest price shown was 14.02 cents per pound in November, 1943.

The monthly average prices compiled by the Department represent weighted averages of the prices received by selected dryers, representing a large proportion of the industry. These prices are for both spray process and roller process nonfat dry milk solids. Obviously, the level of prices is affected by the proportions of spray process and of roller process nonfat dry milk solids entering into the total for each month. Prices for these two types are not quoted separately.

Even with the present wartime demand for the nutrients contained in the nonfat dry milk solids, the returns from it constitute a minor portion of the current value of whole milk. For example, a number of Minnesota creameries early in 1943 estimated the value of the fat in 100 pounds of 3.5 percent milk at approximately three-fourths and the skim milk at one-fourth of the total price paid for the whole milk. (10)

In part, this relatively low value of the skim milk reflects the level established by ceiling prices on nonfat dry milk solids. Milk solids-not-fat in condensed skim milk are commanding about 21 cents per pound on a dry basis. (9) Likewise, the price of 14 1/2 cents per pound for spray process nonfat dry milk solids is much lower than comparable values for equivalent nutrients in the form of evaporated or condensed milk.

NONFAT DRY MILK SOLIDS IS AN EXCEPTIONALLY VALUABLE FOOD

Nonfat dry milk solids contains all the food values of whole milk except the milk fat or butterfat and the substances carried in it. Nonfat dry milk solids contains the milk proteins, the milk sugar, and certain important minerals and water-soluble vitamins which are exceedingly valuable from a nutritional standpoint. With the exception of a few vitamins which are partially destroyed by any heat treatment, there is no indication that any of the elements contained in skim milk are lost in a properly handled powdering process.

The approximate composition of nonfat dry milk solids is:

Protein	37 percent
Lactose (milk sugar)	51 "
Minerals	8 "
Moisture	3 "
Butterfat	1 "
	<hr/> 100 "

It also provides relatively large quantities of riboflavin, which is deficient in many diets, as well as significant amounts of thiamin, niacin, and other water-soluble vitamins. Very likely, too, the long course of mammalian evolution may have caused the nonfat solids of milk to have other nutritional advantages which have not yet been discovered by research.

Perhaps the principal value of nonfat dry milk solids as a food arises from the large proportion of animal protein of the highest type which it supplies. According to Sherman,

"...Thus, the various means of estimating relative values agree in indicating that the proteins of animal origin are, as a class, superior in nutritive efficiency to those derived from plants. Of the animal proteins, those of whole milk and whole eggs share the first place. Next come the animal tissue proteins, among which those of liver and kidney probably have a higher value than those of muscle. Among the nutritionally important plant protein mixtures, those of the cereal grains, although inferior to most animal proteins, have been found to possess a higher value than those of the legumes...." (13)

In this connection, it should be borne in mind that none of the milk protein is contained in the butterfat.

The lactose, or milk sugar, found in nonfat dry milk solids is of unusual value.

"...The rate of digestion, or hydrolysis, of lactose is slower than that of other sugars, and consequently

"its presence persists in the digestive tract for a longer period during digestion than other sugars. This is of distinct advantage to the animal for several reasons. In the first place, lactose favors the growth of *Lactobacillus acidophilus* and promotes carbohydrate fermentation. This, in turn, reduces the formation of toxic decomposition products due to protein putrefaction. Secondly, it is known that lactose favors calcium assimilation...."(8)

There is some reason also to believe that lactose favors the absorption of phosphorus.

With respect to minerals, it should be borne in mind that for Americans, the principal source of the calcium required for sound bones and teeth is the milk elements in the diets. (18) Little is obtained from most cereal preparations since most of the calcium in cereals is found in their outer coats, which are ordinarily discarded. Only moderate quantities are obtained from vegetables and very little from meat. In contrast with these foods, a quart of milk, according to Sherman, contains more calcium than a quart of limewater. In addition, milk contains a liberal supply of phosphorus, which also is important in bones and teeth, as well as moderate quantities of other minerals.

It is evident that nonfat dry milk solids is an exceptionally valuable food. An increased supply is required, in view of the limited quantity of "protective foods" in prospect for this country. This requirement is the more urgent because of the need which will be experienced for such foods in the countries to be liberated, particularly in the feeding of children and invalids.

Uses of Nonfat Dry Milk Solids in Human Diets in the United States

Only a comparatively small proportion of the nonfat dry milk solids consumed as food in the United States is reconstituted and consumed as fluid skim milk. In some institutions, nonfat dry milk solids is reconstituted with cream to produce fresh whole milk, but in general the consumption of nonfat dry milk solids occurs indirectly as an ingredient of various foods.

The outstanding use of nonfat dry milk solids is in the baking industry. It is used in most kinds of bread and also in cakes and cookies. Other uses include ice cream, particularly in the South where supplies of fresh milk are small, sausages and cereals, cake and pancake flour, cream soups, chocolate milk and cultured butter-milk, confectionery, and chocolate. It is used also in the preparation of foods by numerous institutions, but to date it has been used only to a very limited extent in home cooking. Small quantities are utilized in the manufacture of margarine, principally in the South, and also in certain infant foods.

THE NEED FOR NONFAT DRY MILK SOLIDS HAS FAR OUTRUN THE SUPPLY

Sharply increased quantities of nonfat dry milk solids came to be requested early in 1942, when ocean shipping space was greatly reduced by the success of the German submarine warfare. In the earlier stages of Lend-Lease, the demand for dairy products for that purpose had been centered upon evaporated milk and cheese, but with limited shipping available, the emphasis shifted to the most highly concentrated foods which, among the dairy foods, was nonfat dry milk solids. With the slackening in the demand for cheese and evaporated milk, the way was opened for a considerable shift from those products to butter and nonfat dry milk solids, and production of nonfat dry milk solids for human food jumped from 366,000,000 pounds in 1941 to 565,000,000 pounds in 1942. About a quarter of this increase may be attributed to the conversion of a number of plants from animal feed to human food.

Repeated Attempts to Increase Production were Made

At the outset of the Lend-Lease program, when cheese and evaporated milk were keenly desired, it was announced merely that increased quantities of nonfat dry milk solids would be wanted also, and that prices would be supported at levels which would assure liberal supplies. Pursuant to this statement, the price of nonfat dry milk solids for food advanced from approximately 7 cents per pound in April to 12.77 cents in December, 1941.

A goal of 525,000,000 pounds of nonfat dry milk solids for 1942 was announced by the United States Department of Agriculture on December 22, 1941, that the Department was prepared to assist cooperatives in the expansion of their facilities for the production of certain manufactured dairy products, both in financing and in obtaining priorities, and also to assist private concerns in such expansion by aiding with priorities and tax amortization.

On July 21, 1942, the Department advanced the price of spray process nonfat dry milk solids to 14 cents per pound, but lowered the price of roller process to 11 1/2 cents, hoping to stimulate the production of spray process powder. Then on November 30, the Department announced in connection with supports for other dairy products, that prices of nonfat dry milk solids would be supported at 14 1/2 cents for spray process and 12 1/2 cents for roller process powder through June, 1944. These prices were maintained until February 26, 1944, when the price of roller process nonfat dry milk solids was advanced to 14 cents per pound, only half a cent under spray process powder.

No production goal for nonfat dry milk solids was set explicitly for 1943, but various statements emanating from the headquarters of

the Office of Distribution, War Food Administration, indicated a desire for greatly increased output, ranging from 850,000,000 to 900,000,000 pounds for that year.

In response to the incentives provided, production increased sharply to 565,000,000 pounds in 1942, only about 65,000,000 pounds short of the goal set for that year. In 1943, however, it fell off about 20 percent in spite of the continued desire for increased output. Production was smaller in each month in 1943 than in the corresponding month of 1942.

Reasons for Downturn in Production in 1943

Preliminary figures indicate a total for 1943 of nearly 454,000,000 pounds, about 111,500,000 pounds less than the output in 1942. The drop in production was almost 40 percent in November, when milk supplies are seasonally at their low point. Although some recovery was shown in December, the estimate for that month was about 30 percent lower than for December, 1942.

The sharp decrease in 1943 is attributable to the joint effects of a number of factors. It has not been possible to make a thorough analysis of these factors, but to a large degree they have arisen from the keen competition of various uses for the reduced supply of milk under the uneven incidence of governmental regulations upon the commodities involved.

The principal causes for the decrease, not necessarily in the order of their importance, are:

1. Increase in fluid milk consumption
2. Diversion of milk to dried whole milk, 12 percent powdered milk, condensed skim milk, etc.
3. Decrease in milk production
4. Shortage of labor in drying plants
5. Increased use of skim milk in cottage and other soft cheeses
6. More skim milk used in manufacture of margarine
7. Restrictions on sales of fluid cream.

Indications are that the increase in fluid milk consumption is the principal reason for the decrease in the production of nonfat dry milk solids. It is estimated that non-farm consumption of fluid milk in 1943 was more than 20 percent higher than the 30 billion pounds consumed in 1942. This increase, drawn from a slightly smaller total supply of milk, left a materially smaller amount for other uses.

A considerable share of the decrease appears to be attributable to the diversion of milk to the production of dried whole milk, 12 percent fat dried milk, and even some 17 (or other) percent fat

dried milk, and condensed skim milk. 3/ Many plants find it more profitable to produce these commodities. It appears that if a plant had not formerly been producing, say 12 percent milk or dried whole milk, it is rather difficult to apply an effective price ceiling, with the result that prices for these products now are materially higher than the level at which the respective plants would have been willing to sell at the time when price ceilings were established. In addition, there is no set-aside order on those products, so that they can be sold in less than carload lots at the higher prices permitted for such lots.

The production of much of the 12 percent fat dried milk is unfortunate. It appears that a large share of this product is taken by bakers who have been accustomed to the use of nonfat dry milk solids but are unable to obtain it. Thus a number of bakers who formerly did not put butterfat into their bread now are doing so in the face of a severe shortage of butter.

The shift from nonfat dry milk solids to dried whole milk cannot be appraised properly on the basis of the information available, since it is not known how much of the enlarged output is of the roller process and how much is of the spray process type. The increase in the roller process powder appears to represent an evasion of the butter set-aside orders and rationing to a large degree. This product is subject to rapid deterioration. In contrast to this situation, there has been an increase also in the production of spray process dried whole milk made in accordance with rigid specifications and packed in inert gas, usually nitrogen. This product keeps unusually well, even in the tropics, and increased quantities of it are requested for military and other purposes in 1944. Doubtless in large part because of the need for this high type of dried whole milk, an output of 130,000,000 pounds of all dried whole milk is desired in 1944. according to the allocations made by the War Food Administration.

3/ The decrease in the production of nonfat dry milk solids for human food was paralleled by a decrease in the production for animal feed, but the output of dried whole milk increased sharply. Production of all three types decreased nearly 90,000,000 pounds in 1943, but this decrease was offset to an unknown extent by the production of 12 and 17 percent fat dried milk for which data are not available. The preliminary data of production for nonfat dry milk solids and dried whole milk for 1943 and 1942 are, in thousands of pounds:

	1943	1942
Nonfat dry milk solids for food	453,757	565,414
Nonfat dry milk solids for feed	24,124	61,148
Total nonfat dry milk solids	477,881	626,562
Dried whole milk	124,300	62,167
	602,181	688,729

No data are available showing the proportion of dried whole milk produced by the roller process.

In some sections the operators of drying plants complain that they are unable to hold enough men for full operation (three shifts) because of the competition of munitions plants and other plants engaged in defense work, which are able to pay high wages in contrast to the ceilings upon the wages which the drying plants are able to pay. The importance of this factor cannot be determined from the limited evidence available, but it may be a factor in those areas which are close to war plants.

The effect of the increased amount of skim milk used in cottage and other soft cheeses is not large, but it is known that the production of soft cheeses has increased greatly because of the ration points required for other kinds of cheese. The production of margarine likewise has increased greatly, requiring more skim milk. The restrictions on the sale of fluid cream cut down the amount of milk separated in order to provide such cream.

Set-Aside Orders Became Necessary Late in 1942

In spite of the increase in production in 1942, the supply was unequal to the demand in the latter part of that year and markets were firm. By October the supplies were limited and the Agricultural Marketing Administration was appealing to manufacturers to offer as much spray process powder as possible. Then, on November 5, manufacturers of spray process powder were directed to set aside 90 percent of their output of this powder for delivery to designated government agencies. With the supply of spray powder reduced, civilian demand for roller powder increased during November and supplies became inadequate in some markets, in spite of the release of some roller process powder by the Agricultural Marketing Administration. Market supplies grew more and more scanty through the winter and spring and on May 31 the set-aside order was changed, requiring that 75 percent of both roller and spray process nonfat dry milk solids be set aside for delivery to government agencies during May and June. This proportion was maintained through March, 1944.

It is evident that in order to obtain supplies for the armed forces and Lend-Lease, the government has been forced to cut down the amount of nonfat dry milk solids available for domestic consumption in spite of increased needs. As a principal illustration, it may be noted that shortage of nonfat dry milk solids forced the abandonment of the plan to fortify bread by the inclusion of 6 percent of nonfat dry milk solids.

With production following a downward trend during 1943, the shortage of nonfat dry milk solids became more pronounced. The tentative allocation of nonfat dry milk solids for 1944, as announced by the War Food Administration, is:

			Percent of total.
Expected supply	525 million pounds		100.0
Contingency reserve	16 "	"	3.1
Military and war services	58 "	"	11.0
Lend-Lease	260 "	"	49.5
U.S. civilians	158 "	"	30.1
Carryover	33 "	"	6.3

It is notable that the 158,000,000 pounds allotted for domestic civilian consumption in 1944 is much smaller than the apparent domestic consumption of more than 200,000,000 pounds in 1942 and nearly 300,000,000 pounds in 1941. On the surface it is only slightly smaller than the domestic consumption in 1943, but it should be borne in mind that in 1943 the supply of nonfat dry milk solids available for civilians was supplemented by substantial quantities of roller process dried whole milk, 12 percent fat dried milk, and other dried milk compounds. Very little of these products will be available in 1944 because of Food Distribution Order No. 93, and it is obvious that many domestic uses of last year will go unsatisfied this year unless the output of nonfat dry milk solids is increased. These deprivations can be avoided at a moderate cost.

Doubtless the allocations have taken into account the probable need for highly nutritious foods for many people now under German domination who may be liberated this year. Those who have been half starved or worse will need generous supplies of good food to restore them to health. Requirements of this sort will be considerably higher than maintenance requirements and they must be met if it is at all possible. This demand may be materially greater in 1945 than 1944 -- an additional reason for moving promptly to increase the production of nonfat dry milk solids.

VIGOROUS ACTION SHOULD BE TAKEN TO INCREASE THE OUTPUT

From the conditions described in the preceding section, it is obvious that the need for nonfat dry milk solids is urgent. Only in the event of necessity would the domestic consumption be cut as sharply as is indicated by the allocation for 1944. Other indications point further to increased need for this commodity, especially in the event of short crops in 1944 or 1945. All the evidence leads to the conclusion that steps should be taken promptly to obtain a substantial increase in the production of nonfat dry milk solids. An increase of 325,000,000 pounds per year, bringing the annual production up to 850,000,000 pounds for human food, is recommended.

This amount, which is the lower figure suggested by the Food Distribution Administration in 1943, is nearly 400,000,000 pounds greater than the 1943 output and about 285,000,000 pounds in excess of the 1942 production. The lower figure suggested for 1943 is taken as the goal, in view of the fact that increased quantities of dried whole milk also are being requested by the War Food Administration for military and Red Cross purposes. That for the Red Cross includes the dried whole milk packaged for shipment to our men held as prisoners of war. An output of 130,000,000 pounds is expected in 1944. Should this rate be maintained and the production of 850,000,000 pounds of nonfat dry milk solids be achieved, the combined figure would equal nearly a billion pounds per year for human consumption.

An increase of 325,000,000 pounds of nonfat dry milk solids per year would provide approximately 100,000,000 pounds of animal proteins of the highest type. It would likewise make substantial amounts of calcium, phosphorus, and certain vitamins, including riboflavin, available for human food annually. None of these nutrients is over-abundant and riboflavin especially tends to be deficient in many diets. In addition, the suggested increase would provide more than 150,000,000 pounds of lactose, or milk sugar, which may be especially valuable in connection with the assimilation of calcium and phosphorus. (See above, pp. 10-11)

Leading Authorities Urge an Increased Supply

Greater use of the milk solids other than fat for human food rather than for animal feed is advocated, with no dissenting voices, by practically all serious students of the food problems confronting the United States in the present emergency. Recognizing that these nutrients are exceptionally valuable, these authorities concur that an increased proportion should be promoted to a food status.

In a discussion of the protein situation, the National Research Council gives first place to increasing the proportion of skim milk

to be used as a food rather than as a feed. (14) Nearly a third of the national protein intake in 1942, it was estimated on the basis of the 1942 production goals, would originate in milk in fluid form and in various manufactured dairy products, but because a large share of the milk proteins was fed to animals, the report urged a substantial increase in the proportion used for human food.

Greater use of milk solids other than fat in human nutrition likewise is strongly urged by the Sub-Committee on United States Food Allocation Policy which was appointed by Secretary Wickard. (6) This Sub-Committee emphasized the importance attached by nutritionists to the solids-not-fat in milk. It pointed out that there was an average loss of about 80 percent in feeding skim milk to animals which, in turn, would provide food, and it recommended that an increased amount of skim milk be powdered for human food.

Among others, T. W. Schultz points out that cows are highly efficient converters of feed into human food if all milk products are utilized, but much less efficient if only the butterfat is used for food. Accordingly, he urges increases in the proportion of milk used in the form of fluid milk and in dried milk, including nonfat dry milk solids. (17) A. H. Lauterbach suggests that in a time of world food shortage, such as now confronts us, very little skim milk should be fed to animals. (11) Hoard's Dairyman observes that it is unfortunate to talk of restricting consumption of milk products in this country while so large a proportion of the solids-not-fat is being fed to animals. (7)

Protein May Be in Scant Supply

One of the principal reasons why an increase in the production of nonfat dry milk solids is favored so strongly is the possibility of scanty supplies of protein in the early post-war period. Such a possibility was envisaged by the National Research Council in 1942 as a result of a survey of the probable supplies of protein. Its report concluded that:

"While a protein shortage certainly is not imminent (in 1942), this fact certainly does not exclude the possibility that it may occur at the expiration of the war... The demand for high-protein foods, of the sort to which we and the British are accustomed, may exceed the production facilities of the two countries, particularly during the critical period of economic readjustment immediately following the cessation of hostilities...." (14)

The supply of animal proteins was increased materially in 1943 over the indications available to the National Research Council in 1942, but this supply is likely to be reduced materially after the

marketing of the very large 1943 pig crop has been completed. ^{4/} Insufficient feed is in prospect to maintain the 1943 rate of animal production. Partially in recognition of this fact, the support price for hogs was lowered from \$13.75 to \$12.50 per 100 pounds, effective October 1, 1944. Material reductions in hogs and chickens may be expected and even with continued good crops, the supply of animal proteins presently may be much the same as that contemplated by the Council in 1942.

In view of this prospective reduction in the supply of animal proteins, the necessity of placing greater reliance upon vegetable proteins in the future is being pointed out in numerous articles emanating from various sources. Generally speaking, vegetable proteins are less valuable than animal proteins, although it appears that within limits, a combination of vegetable proteins with at least some animal proteins, is practically as efficient as the animal protein. Nonfat dry milk solids is especially valuable in supplementing vegetable proteins.

Possibility of Short Crop Emphasizes Need for Increase

Even with continued good crops, it is evident that there is real need for an increased supply of nonfat dry milk solids. In the event of short crops in 1944 or 1945, the need would be intensified, since the supply of all nutrients would be reduced sharply and it would be imperative to conserve as much of it as possible.

There is no assurance that our succession of unusually good crops in the United States will be continued; in fact, the probability is otherwise. We have been favored with seven good years and outturn was notably high in 1942 and was nearly equaled in 1943. It is hoped that crops will be good this year and the next, but so long a succession of consecutive favorable years is unlikely, and the deficiency of moisture in important areas of crop production is a disturbing factor. Prudence suggests the advisability of taking such a possibility into account.

In view of these circumstances, there is all the more reason for adopting measures to increase the production of nonfat dry milk solids. The increase suggested will be worthwhile even if good crops are continued; it may be very valuable if crops are short in 1944 or 1945.

^{4/} Daily civilian consumption per capita of animal proteins in the United States was very slightly higher in 1943 than in 1942. See The National Food Situation (Bureau of Agricultural Economics, United States Department of Agriculture, November 1943), cover page

INCREASE MUST COME MAINLY FROM SKIM MILK NOW FED

Approximately four billion pounds more of skim milk than were dried in 1943 will be required if the annual production of nonfat dry milk solids is pushed up to 850,000,000 pounds per year. A minor part of the increase over the 1943 output may be drawn from milk used in 1943 in the production of 12 percent dried milk and kindred dried milk compounds and perhaps a little may be diverted from milk which went into condensed skim milk. Most of the proposed increase, however, will have to be drawn from the skim milk now fed to animals on farms.

Little, if any, of this increase can be obtained advantageously from the milk now going into fluid milk, evaporated and condensed milk, cheese and ice cream. Although the consumption of fluid milk has increased materially (see p. 13), it should be borne in mind that even at the current rate the consumption of fluid milk is below the level recommended by leading nutritional authorities. As an emergency measure, minor reductions in consumption in the larger centers are being occasioned by Food Distribution Order No. 79, which is being extended to smaller cities, but a general attempt by governmental agencies to effect larger reductions would result, not only in nutritional disadvantages, but also in administrative difficulties. It is better to attract more of the skim milk now being fed on farms.

No reduction in the milk going into the production of evaporated milk and into cheese is desired. Both are in demand for our armed forces, Lend-Lease, and domestic consumption. Nor is a reduction in the amount of skim milk going into cottage, pot and bakers' cheese wanted, beyond the provisions of Food Distribution Order No. 79 and its extensions, since they are needed to replace other types of cheese which are less perishable.

Restrictions already have been placed on cream sales, both with respect to fat content and to quantities which may be sold, and sharp reductions have been made in the milk content of ice cream.

Increase Will Require Only Minor Portion of Skim Milk Now Fed

More than six times the increased amount desired was fed on farms in 1943. Approximately 30 billion pounds of skim milk was fed on farms in 1942 (4), but the amount was smaller in 1943, both because of a reduction in the amount of milk produced and of a further shift to whole milk delivery in numerous communities. Perhaps 27 billion pounds were fed in 1943.

This feeding of skim milk on farms was concentrated to a large degree in the west North Central States. On the basis of the 1942

figures, nearly 65 percent was fed in ten States, including: 5/

				<u>Cumulative</u>		
Minnesota	5,492	million	pounds			
Iowa	4,522	"	"	10,014	million	pounds
Nebraska	1,909	"	"	11,923	"	"
Kansas	1,768	"	"	13,691	"	"
North Dakota	1,712	"	"	15,403	"	"
Missouri	1,422	"	"	16,825	"	"
South Dakota	1,311	"	"	18,136	"	"
Oklahoma	1,311	"	"	19,447	"	"
Michigan	1,122	"	"	20,569	"	"
Illinois	1,069	"	"	21,638	"	"

The fact that these States lead in the amounts of skim milk fed on farms does not necessarily mean that they also lead in milk production. Minnesota produced much less than Wisconsin, but so large a proportion of the Wisconsin milk was delivered as whole milk to milk plants and cheese factories that comparatively little was separated on farms. Likewise, such States as New York, California, Pennsylvania and Ohio produced much more milk than did some of the States listed above, but most of it was delivered as whole milk and little skim milk was retained for farm feeding. In some States, as Iowa and the Dakotas, nearly all the milk is separated on farms and the skim milk is fed.

Some Factors Affecting Procurement of Skim Milk

On the basis of the above data only, the problem of obtaining the skim milk for drying would seem comparatively simple. A number of other factors, however, must be taken into consideration, including the density of milk production in the areas where drying facilities are available or can be provided and the value of skim milk for feeding. When all conditions are weighed, it may be found that some of the States which show comparatively little skim milk fed because most of the milk already is delivered as whole milk, may provide more additional skim milk for drying than certain of those in which the amounts fed are comparatively large.

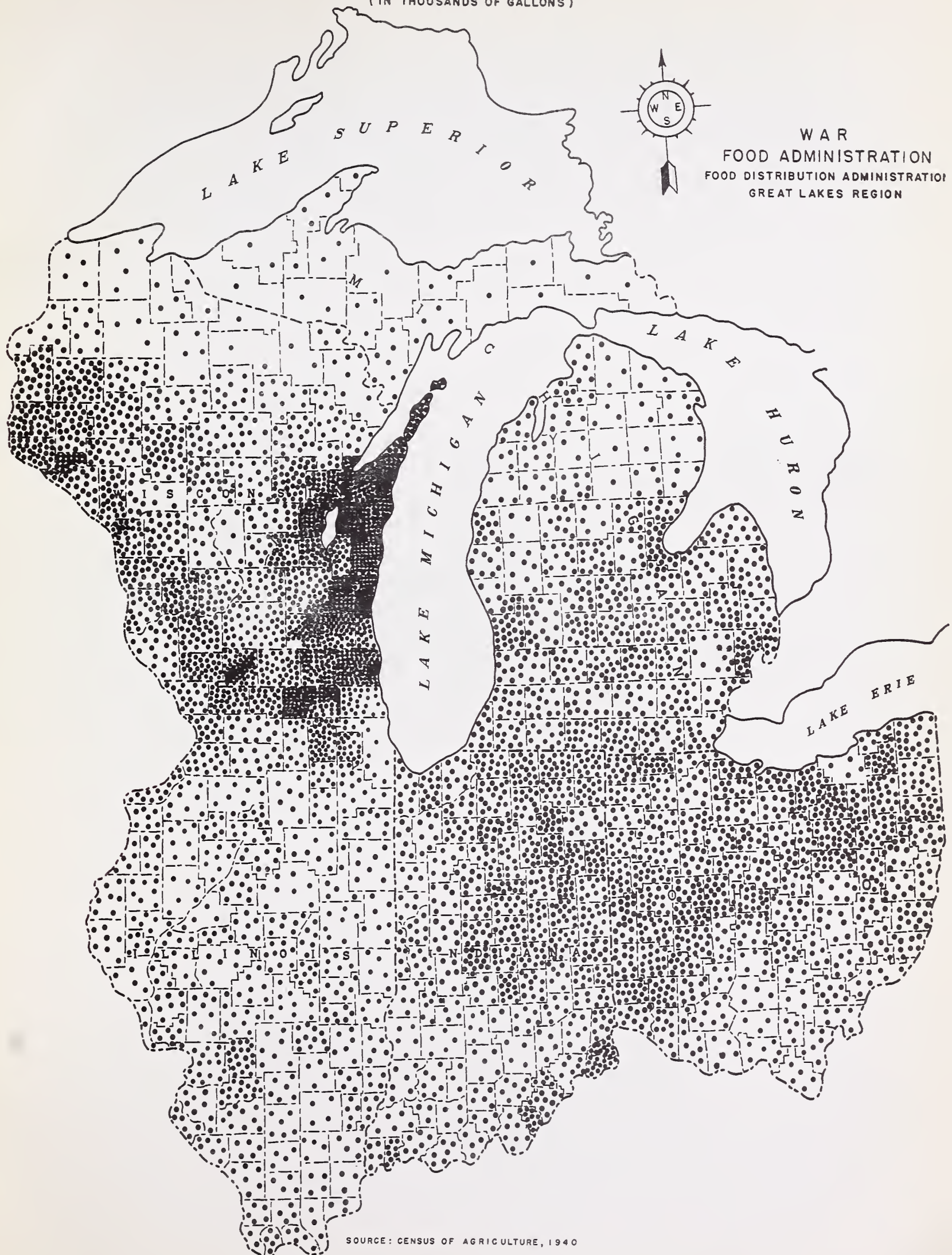
With respect to the density of production, it is generally known that there are wide variations, not only from State to State, but also among localities within States. For the present purpose it may be profitable to consider both the total milk production and the quantity of skim milk fed, which may be inferred from the sales of butterfat. Such differences are brought out by a comparison of

5/ Computed on the basis of 87 percent of the milk represented in each state by cream sales and farm churnings of butter. Data taken from Farm Production, Disposition, and Income from Milk, 1941-1942 - U. S. Department of Agriculture, Bureau of Agricultural Economics, April 15, 1942

county data for seven States of the Midwest Region, showing for 1939 the gallons of milk produced per square mile and the number of pounds of butterfat sold from herds of four or more cows. These data are presented in graphic form in figures 1 to 4. 6/

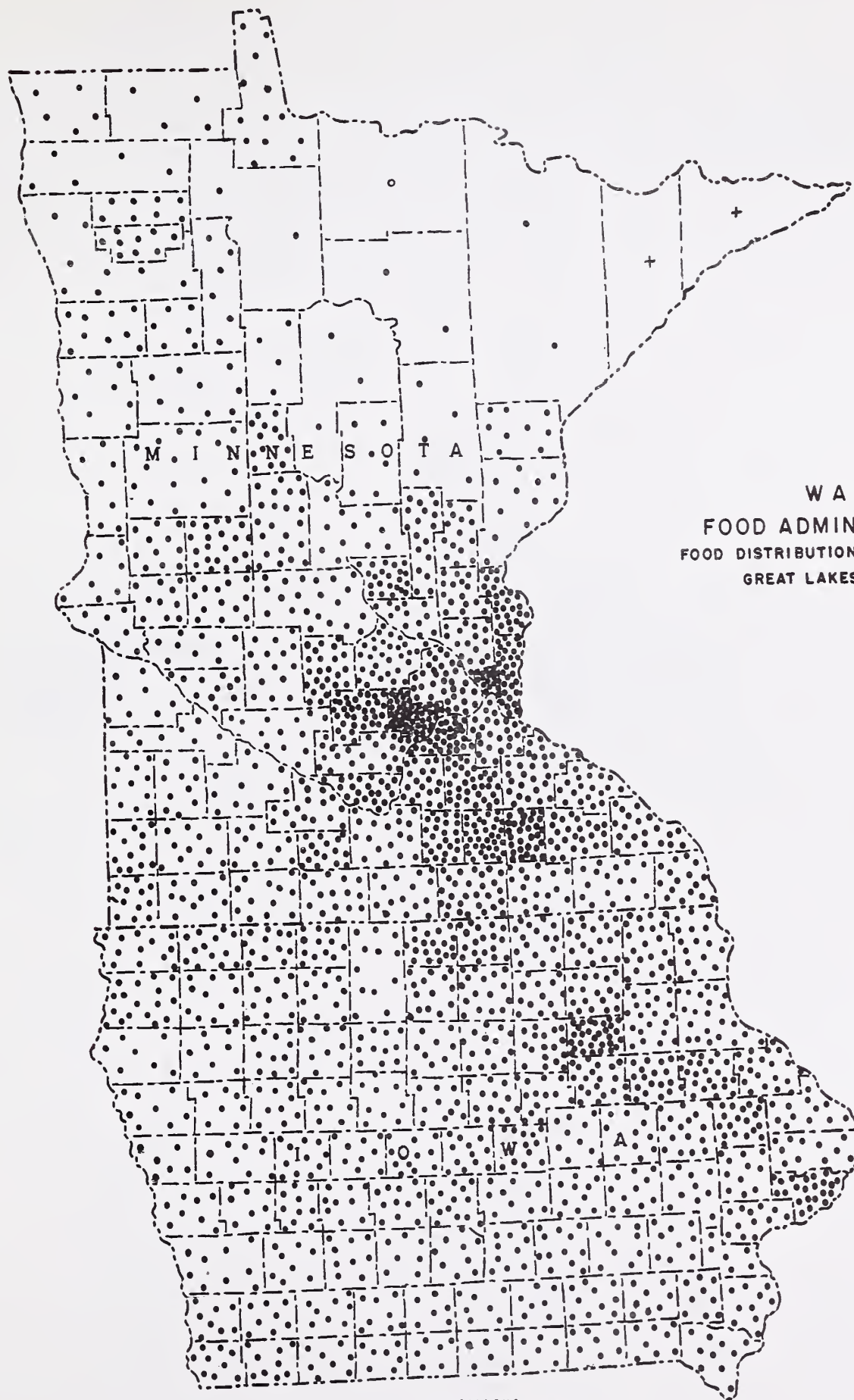
6/ The charts for the five Great Lakes States were prepared because at that time they constituted the Great Lakes Region of the Food Distribution Administration. When the Midwest Region was formed, the charts for Minnesota and Iowa were added.

MILK PRODUCED PER SQUARE MILE, BY COUNTIES,
IN THE GREAT LAKES REGION
(IN THOUSANDS OF GALLONS)
IN 1939



SOURCE: CENSUS OF AGRICULTURE, 1940

GALLONS OF MILK PRODUCED PER SQUARE MILE IN 1939, BY COUNTIES,
IN MINNESOTA AND IOWA. TOTAL FOR ALL COWS MILKED.



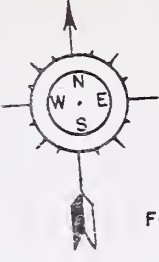
WAR
FOOD ADMINISTRATION
FOOD DISTRIBUTION ADMINISTRATION
GREAT LAKES REGION

KEY:
● = 1,000 GALLONS
○ = 500-999 GALLONS
+ = LESS THAN 500 GALLONS

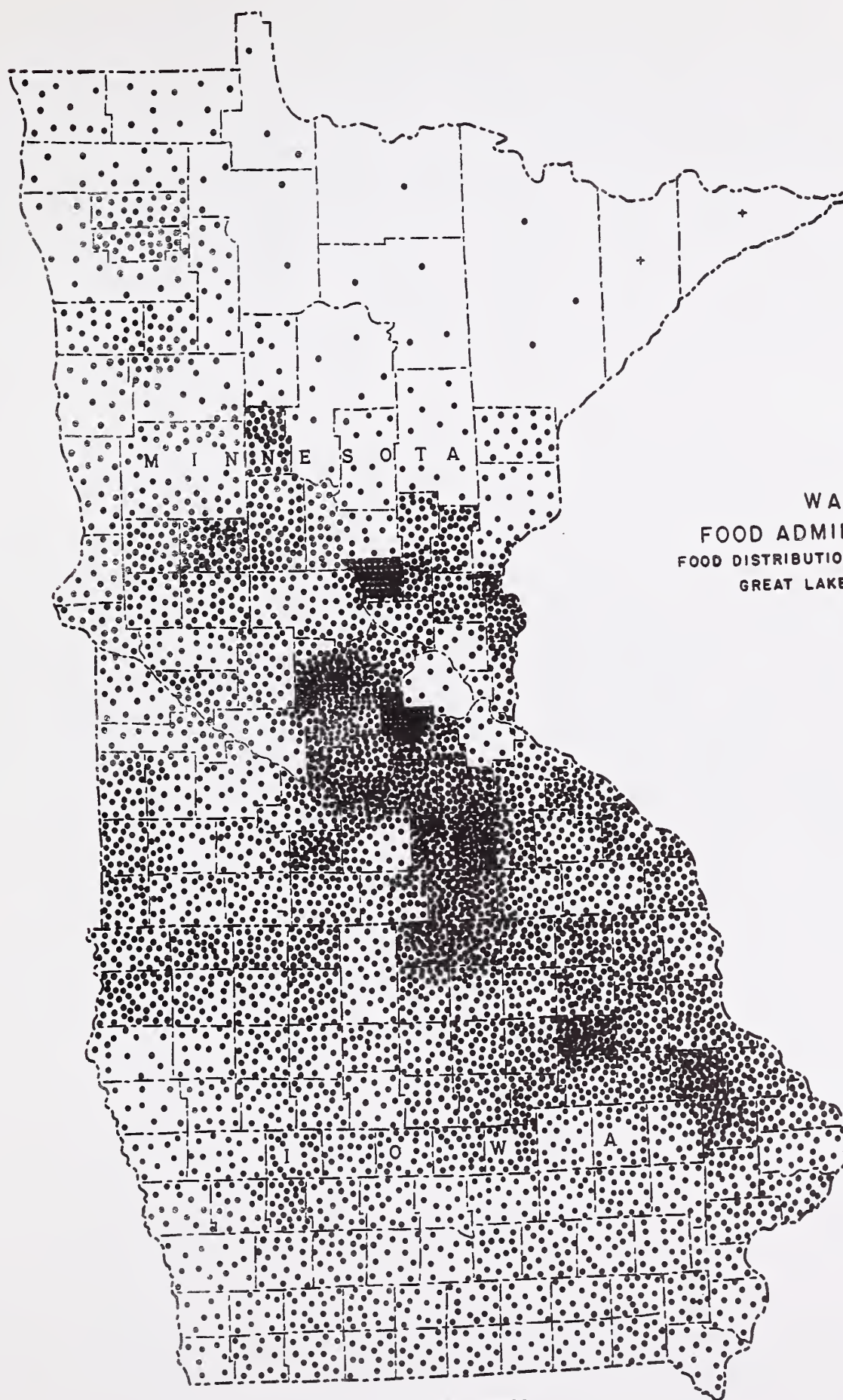
SOURCE:

AGRICULTURE CENSUS, 1940.

25



BUTTERFAT SALES PER SQUARE MILE IN 1939 FROM HERDS OF
MORE THAN 3 COWS, BY COUNTIES, IN MINNESOTA AND IOWA.



WAR
FOOD ADMINISTRATION
FOOD DISTRIBUTION ADMINISTRATION
GREAT LAKES REGION

KEY: ● = 100 POUNDS
○ = 50 POUNDS
+ = LESS THAN 50 POUNDS

SOURCE

AGRICULTURE CENSUS, 1940.

Examination of these charts reveals that within the States, the areas of heaviest milk production do not always coincide with the areas of heaviest farm feeding. It may be assumed that the feeding of skim milk is reflected by the sales of butterfat, since there are very few whole milk creameries. Thus, in Wisconsin, the greatest milk production is found along the shore of Lake Michigan and in a few nearby counties as far north as Door County, but the heaviest sales of butterfat occur along the western border. In Illinois, the heaviest milk production is found in the northern tier of counties, but comparatively little butterfat is sold from those counties. In Minnesota and Iowa there is a much closer relation between milk production and sales of butterfat from herds of four or more cows. It is recognized that conditions have changed materially since 1939, but county data were not conveniently available for more recent years, and these figures afford some basis for comparisons.

Further examination of the charts showing butterfat sales discloses that there are numerous localities in these seven States where such sales were comparatively large in 1939 and others in which sales were small. Such sales, indicating large amounts of skim milk used for feeding, were heavy in western and central Wisconsin, in the southeastern quarter of Minnesota, and in the northeastern quarter of Iowa. Substantial sales were shown also in other portions of Iowa and Minnesota, in central Michigan, and northeastern Indiana. Other variations are apparent from locality to locality in these States. A preliminary survey of comparable data for other States revealed that similar variations in butterfat sales occur in them as well. Even though there has been a significant swing away from farm separation to whole milk delivery in many localities since 1939, it is probable that these variations persist to a considerable extent.

Only the herds of four or more cows were considered in computing the sales of butterfat by counties for the purpose of indicating the supplies of skim milk which might be drawn upon for the production of nonfat dry milk solids, because it seemed less likely that the farmers having the smaller herds would be interested in shifting to whole milk delivery. Most farmers who milk only one or two cows do so to provide milk and cream for their own use rather than to obtain income from the milk, and even a farmer who milks three cows at least part of the time may be presumed, on the whole, to be little interested in selling whole milk rather than skimming or separating it on the farm. The exclusion of the herds of three cows or fewer is arbitrary, but it is believed to be in accordance with conditions.

Further information concerning the variations within the seven States is presented by the variations in the average number of cows milked per farm in each county. The county ranges for the

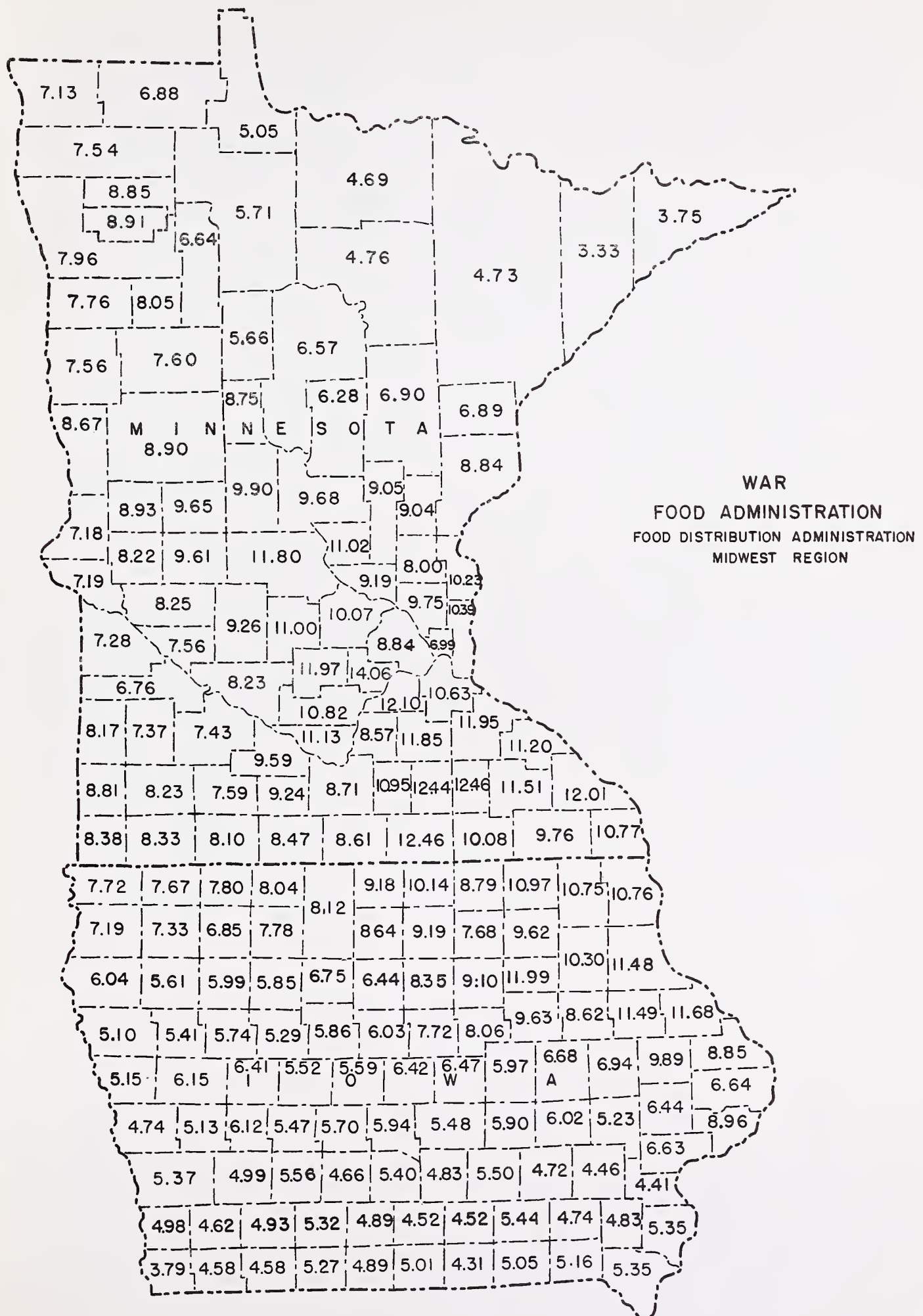
individual States are:

<u>State</u>	<u>Average Number of Cows Milked</u>
Illinois	2.3 - 19.9
Indiana	2.4 - 7.6
Iowa	4.3 - 12.5
Michigan	3.4 - 7.9
Minnesota	3.3 - 12.5
Ohio	2.5 - 7.6
Wisconsin	3.9 - 20.2

Differences among the counties in these States are shown in figures 5 and 6.

AVERAGE NUMBER OF COWS MILKED PER FARM, BY COUNTIES,
IN THE GREAT LAKES REGION
IN 1939



20
RE

SOURCE: CENSUS OF AGRICULTURE, 1940

Similar variations among counties in the average number of cows milked per farm are shown by other States. These figures differ from the data of milk production per square mile in being influenced by the average size of farms as well as by the production per cow. They also throw some light upon the dairy conditions in certain of the States from which the additional skim milk for drying must be drawn if a substantial increase in the production of nonfat dry milk solids is to be obtained.

Obviously, if other conditions are equal, it would be desirable to draw the supplies of milk for drying from communities with maximum density of production in order to keep down the costs of assembling. It would be helpful to have the requisite quantity produced comparatively close to the drying plant, thus minimizing the expenditure of gasoline and rubber, and also to load comparatively large quantities at each farm, in order to reduce the number of stops. Other factors, however, must be taken into consideration, such as the condition of the roads, the distance which a farmstead is set back from the road, and in some areas, whether or not a road serving one or more farms may be temporarily impassable because of snow or mud.

Feeding Demand for Skim Milk is Variable

The value attached to supplies of skim milk as a feed, particularly to young calves, pigs and chickens, varies from farmer to farmer, but in general the value is much higher if a farmer has a large number of young animals and limited supplies of skim milk for feeding than if the reverse were true. Likewise, the value of skim milk as a supplement is likely to be high if the farm provides ample quantities of carbohydrates but comparatively little protein.

In part for this reason, it has been much more difficult to obtain whole milk deliveries in the corn-hog sections than in the areas of intensive dairying. For example, Quintus and Stitts, in commenting on the fluid milk situation in Iowa about 1935, observed that:

"The expansion (of membership in fluid milk organizations) tends to stop sooner than one might at first expect in view of the heavy milk production in the State. ...most Iowa farmers are not typically dairymen and they are not interested in supplying fresh whole milk daily as a side-line enterprise, even at some premium...." (16)

The rule of thumb value of skim milk is that when protein supplements have to be purchased, the skim milk is worth half a bushel of corn. If no high protein feeds happen to be available, the value of the skim milk is appreciably higher. Of course, in estimating the value of skim milk in such circumstances, the appropriate value for a bushel of corn is not the ceiling price but

the return which the farmer can obtain by feeding it. On such a basis, the value of skim milk to many farmers in 1943, with high prices for hogs, chickens, and eggs, may well have been more than 75 cents per 100 pounds on the farms. Such a level was higher than the returns to be obtained from roller process dried skim milk in most plants in that year.

In contrast to the situation in the corn-hog areas, it is apparent that many farmers in areas of intensive dairying place comparatively low values upon their skim milk and are willing to part with it at low prices. In a number of instances, it may be concluded that farmers have been willing to part with their skim milk for materially less than its value to them as a feed.

Even in many localities in which the delivery of whole milk is the common practice, small numbers of farmers prefer to separate their milk and retain the skim milk for feed. In some instances, breeders of pure bred stock, who command high prices for their animals, find it profitable to feed their skim milk; some hog growers wish to push their pigs along rapidly in order to catch a more profitable market; and some farmers have been accustomed to the use of skim milk in feeding and are unwilling to change their ways.

In one Wisconsin community, about 50 of 600 patrons of a creamery still sold butterfat even after the others had shifted to whole milk delivery. Then, too, some farmers separate part of their milk to provide some skim milk for feeding, but deliver most of the milk as whole milk. It is not uncommon in some localities for some farmers to separate their milk for a time after their pigs have been weaned.

Additional Facilities Will Be Needed

Only a small part of the estimated four billion pounds of skim milk to be diverted from farm feeding to the production of nonfat dry milk solids for human food is produced in localities where drying facilities are at hand. It is true that some farmers in communities where their neighbors already are delivering whole milk may also shift to whole milk delivery, but most of this additional skim milk will have to come from localities where farm separation is the rule. As a consequence, it will be necessary to provide drying facilities such as plant equipment, trucks, cans and farm cooling equipment for a large number of localities in order to attain the goal proposed.

If there were numerous whole milk creameries, receiving whole milk from their patrons and returning the skim milk, from which skim milk could be obtained for drying, the problem would be simpler, since in that case the separating equipment at the creamery, the trucks, the cans and the farm cooling equipment already would be at hand. Indications are, however, that only a very limited amount

of nonfat dry milk solids can be obtained from such whole milk creameries. There are very few of them and some of them may prefer not to engage in drying operations. Most of the skim milk for drying will have to be drawn from localities in which butterfat is delivered to the creameries. In some instances, the butterfat may be collected two or three times a week by cream trucks; in others, it is taken to the creamery by the farmers themselves when someone in the family chances to be going to town. In the latter type of community, all necessary facilities will have to be provided if skim milk is to be obtained for powdering.

Some assistance may be necessary in obtaining the requisite number of cans, but it appears that the situation in both tin and steel is less serious than it was. It is believed that cans may be provided without serious difficulty.

With respect to trucks, the observation may be pertinent that the whole trucking situation is very tight and it is quite possible that in some localities it may be practically impossible to obtain an adequate supply for increased hauling of skim milk, as well as for other purposes, until the end of hostilities in Europe. Some time must elapse, however, before other facilities can be provided, and if trucks should constitute a bottleneck, it might be desirable to request that some be released from military supplies for the purpose of increasing the output of nonfat dry milk solids.

Milk drying equipment will have to be provided for a considerable number of localities. In some places it may be possible to take over spray process plants erected for egg drying, since that program now promises to be less active. Such plants, however, will require the addition of milk receiving and handling equipment, and unless the buildings were designed for such equipment, the conversion to milk drying may entail considerable expense, even though part of the facilities are at hand. In other places, it will be necessary to begin at the bottom, particularly if the boiler capacity of the creamery is inadequate for drying purposes.

Farm cooling equipment will have to be provided for practically all the farms involved which formerly separated the cream on the farms. Even on the farms where cooling equipment was used for cream, it is unlikely that the cooling space will be adequate, since the shipment of milk requires about four times as much space as cream. On other farms where the cream commonly is placed in cellars, or caves, it will be necessary to provide new cooling facilities for all the milk shipped. Fortunately, a cooling tank inserted between the pump and the supply tank or stock tank is not very expensive and affords satisfactory results in nearly all instances.

Additional Inducements Will Be Required To
Attract Requisite Quantity

There is reason to believe that most of the communities in which farmers place relatively low values upon skim milk for feeding already have shifted from farm separation to whole milk delivery and that greater inducements than were offered a year ago will be necessary to obtain approximately four billion pounds of skim milk for drying. Certain of these are now in operation. The dairy feed subsidy, which has provided varying differentials for whole milk over the sale of butterfat, tips the balance strongly toward the delivery of whole milk and the recent advance of 1 1/2 cents per pound for roller process nonfat dry milk solids will enable the roller plants to compete much more strongly with the feeding demand for skim milk. It appears also that the demand from pigs and chickens for skim milk may be less keen in 1944 than it was in 1943, because of the prospect for lower support prices for hogs, beginning October 1, 1944, and the drop in egg prices in January, 1944. It is possible that the price level of nonfat dry milk solids, including the effects of the dairy feed subsidy, may attract enough skim milk, provided that other prices do not get out of line.

The main additional inducement required is assurance of a continued market for the product. Many creameries are apprehensive lest the demand for nonfat dry milk solids may drop off sharply after the end of the rehabilitation period, thus forcing them to discontinue drying operations and to refuse to accept whole milk from their patrons. The same apprehension causes many farmers to hesitate concerning shifting from farm separation to whole milk delivery and undertaking to make the necessary changes in his farm operations. Very likely they assume that those who are among the last to engage in drying operations may be among the first to be crowded out if demand slackens.

It should be borne in mind that in the ordinary course of events, considerable time must elapse before arrangements for milk powdering can be made and operations can begin. Even in the case of an individual creamery, if the question has not been considered previously, it is necessary to ascertain the proportion of the patrons willing to shift from cream sales to whole milk delivery before a decision to engage in drying can be reached. Then the necessary drying equipment and other facilities must be obtained in the face of the need for priorities, delays in manufacture, and other difficulties. Few creameries whose plans for drying are not already under way can hope to begin operations before the latter part of 1944 at the earliest, and many may not be able to do so until some time in 1945. Then several years of profitable operations commonly are required to equal the cost of the facilities before the undertaking can show a net profit. Likewise, many of the patrons who shift to whole milk delivery are likely to experience feeding difficulties until they have become adjusted to the new conditions and

have learned what elements must be added to replace the skim milk. For these and other reasons there is reluctance in many quarters to engage in drying operations for what some fear may be a comparatively short time.

In considering the matter of the inducements needed, it should be borne in mind that it will be desirable to persuade a relatively large proportion of the farmers in each new locality where drying operations are begun to shift promptly to whole milk delivery. This will be necessary if the facilities are to be employed to advantage. Such quick shifting, however, is unusual. In the ordinary course of events, the patrons who first deliver whole milk when a creamery begins to manufacture nonfat dry milk solids are a minority. The proportion increases from year to year as farmer after farmer decides that whole milk delivery is advantageous for him. Additional effort will be required to speed up this process.

Use of Government funds as grants to help defray the cost of erection of farm cooling facilities will provide a considerable incentive in connection with publicity concerning the need for nonfat dry milk solids. Announcement that grants of perhaps \$30 per farm will be made for this purpose for a limited time only will aid in obtaining prompt action on the part of a number of farmers who otherwise would tend to delay their decisions on shifting to whole milk delivery.

It is contemplated that Government funds will continue to be employed in providing drying facilities on at least as liberal a basis as before. Some extension of this practice will be justified if it aids in holding down other inducements necessary to persuade an adequate number of plants to enter the field of milk powdering. It should be borne in mind that those plants which begin operations late will enjoy a comparatively short period of the most profitable operations and also that in general, they will have to draw their skim milk from patrons who place a comparatively high feeding value upon it.

ANNUAL OUTPUT OF 850,000,000 POUNDS IS PRACTICABLE

From the foregoing material it is evident that more nonfat dry milk solids is urgently needed and that there is an ample reservoir of skim milk now fed on farms from which a substantial increase can be drawn. But how about the cost? In terms of materials and man hours, is such a program justified under present conditions? Or is it better to get along on a restricted amount of this commodity for a few years, lest the combination of wartime costs and the difficulties of a postwar surplus should exceed the immediate advantages? These are real questions and require definite answers, although it is obvious that the answers must be based largely upon estimates of conditions which are likely to prevail in the future.

In reply, it may be stated that the necessary facilities can be provided without undue difficulty. The best evidence available indicates also that the increased output can be absorbed by domestic consumption at a comparatively early date after the end of the war, provided that assistance can be afforded during the period of transition. Thus, the overall costs of the increase in supply may be surprisingly low in comparison with those of most commodities produced in response to war needs, principally because in nonfat dry milk solids it is possible to take advantage of the upward trend in a growing industry.

Increase Will Be Acceleration of Trend

Production (and consumption) of nonfat dry milk solids had been increasing rapidly before the outbreak of war. Total production, including that for feed doubled five times from 1916 to 1942, as shown by the data on page 7. Official data of production for human food were not compiled until 1935, but production nearly doubled from that year to 1940. Then it increased moderately in 1941 under the stimulus of Lend-Lease purchases and jumped in 1942 in response to war demands.

Doubtless the explanation of this rapid growth is to be found in the low price at which this commodity could be produced. As a by-product of butter and fluid cream, its cost was very low, since the lion's share of the cost of production was attributed to the major commodity. Even in 1943 the value of the solids-not-fat in 100 pounds of milk was considered as about one-fourth of the total value of the milk for the manufacture of butter (10); in the production of fluid cream, the value attributed to the solids-not-fat may have been materially lower.

Putting it another way, the nonfat dry milk solids has competed with feed uses of skim milk for its raw material, with the result that this commodity can be produced at prices which are decidedly low in proportion to its value. When allowance is made for the value of the butterfat, the milk solids other than fat contained in nonfat

dry milk solids are much below the levels of the comparable nutrients contained in cheese or evaporated or condensed milk. Further, the nonfat dry milk solids is more compact and requires less care in storage than either cheese or evaporated milk. In view of these circumstances, it is not surprising that new uses have been found for this commodity and that its production has increased rapidly.

If the war had not intervened, it is quite possible that the annual production and consumption of nonfat dry milk solids for human food would have reached 850,000,000 pounds by 1950. Admittedly, this possibility would have been governed to a large degree by the ingenuity displayed in devising the packages best suited to the uses of diverse types of consumers and by the vigor with which education in the value of this commodity was pressed, but there is no reason to assume that either of these elements would have been lacking. To bring the output up to the rate of 850,000,000 pounds per year early in 1946, will mean merely that rate of increase in production must be stepped up in response to war needs.

Domestic Requirements Can Absorb Increased Output

There is good reason to believe that domestic consumption is capable of increasing to the point of absorbing the suggested goal of 850,000,000 pounds and perhaps much more in good time, but it must be borne in mind that while production has expanded rapidly in response to war demands, domestic civilian consumption has been restricted severely. Thus, it has been impossible for consumption in this country to keep pace with production. Even if a vigorous program is adopted to increase production of nonfat dry milk solids, it will be some time before the more pressing needs for this commodity can be met and many would-be users will be forced to turn to substitutes. Considerable dislocation of production-consumption relationships is unavoidable.

In view of this dislocation, it is only fair that appropriate measures be adopted to aid in handling part of the output in the event that overseas demand for nonfat dry milk solids falls off more rapidly after the end of the rehabilitation period in Europe than domestic consumption can be expected to increase. It is possible that this will not be the case but the chances are more than even that it will be, and the possibility represents a risk which is viewed with anxiety by nearly all producers of the commodity.

Several items of information suggest that European demand may fall off rapidly after the end of the period of rehabilitation there. First, the need will be less keen. Underfed people will require larger proportions of highly nutritious foods, such as nonfat dry milk solids, to restore them to health than will be required to maintain health. Thus, less actually may be needed after the close of rehabilitation than during that period.

Second, it is believed that few countries of continental Europe are likely to purchase as much nonfat dry milk solids when they have to finance their own purchases as will be donated to them during the rehabilitation period. Even though the product may have been received gratefully during that period, it is likely that the governing authorities will tend to buy it sparingly, even though it will be the most economical source of many nutrients, particularly if funds are limited and industrial products are desired. In this connection, it should be borne in mind that many of these countries have not been accustomed to the extensive use of milk products in their diets.

Third, the possibility of competition should not be overlooked. With respect to the United Kingdom, it is probable that the demand for nonfat dry milk solids will be maintained at a higher level than may be the case with most countries of continental Europe, but there is the possibility that a large share of such needs may be supplied presently by one or more of the Dominions. Little evidence has been found of a milk drying industry in New Zealand, but interest in it has been expressed, at least to the extent that representatives of that country have inspected milk drying plants here. Conditions there are favorable for the powdering of skim milk, since a large part of the butter is produced under conditions of intensive dairying with comparatively little feeding outlet for the skim milk. Since New Zealand frequently has exported more than 250,000,000 pounds of butter per year, it might easily be possible to export well in excess of that quantity of nonfat dry milk solids if sufficient incentives were present.

There is the possibility, however, that even if New Zealand should plan to compete vigorously for the dried skim milk market in the United Kingdom, the extensive erection of plants and installation of equipment might be delayed after the end of the war, if it appeared that a comparative surplus and low prices were likely to prevail for a few years. This condition is highly conjectural, but it may be worthy of mention.

Fourth, demand from our armed forces will be cut down decidedly after the end of the war, if for no other reason than that the Army will become much smaller and the Navy may have fewer men to feed. Not quite 12 percent of the expected supply for 1943-44 was allotted to the armed forces, but it is to be expected that their takings will be reduced, even though the available supplies may be much larger than those expected for that year.

The above considerations suggest that foreign demand and demand from our armed forces may fall off rapidly after the end of the rehabilitation period, with the result that domestic demand may not be equal for a time to the amount which will be available. It is possible, however, that the reduction in foreign demand for nonfat dry milk solids will be more gradual and that domestic consumption will have more time in which to catch up with the expanded production. In that event there will be comparatively little need for

Governmental assistance during the transitional period.

At the same time that foreign demand may fall off, it is very likely that production will increase slightly. Labor shortages will be relieved and very likely the demand for fluid milk will lessen, both because of somewhat lower incomes on the part of a number of consumers and because automobiles, radios, etc., will again compete strongly for the consumers' dollars. It is suggested that such increases may overbalance the normal decreases to be expected from scattered plants, and that annual production shortly after the end of the war may well amount of 900,000,000 pounds per year.

It is hardly to be expected that domestic consumption which has been severely restricted will be able to increase as rapidly as war and rehabilitation demands may fall off. A start in that direction may be made if production is increased in 1944 and 1945, but until supplies for domestic use are much larger than they are at present, there will be little opportunity to develop new uses for nonfat dry milk solids or to devise new merchandising methods for its wider distribution.

When liberal supplies again are available, there will be a great deal of work to be done in presenting this commodity to consumers. The situation will constitute a challenge to merchandising ingenuity, it is true, and doubtless a great deal of experimental work will have to be done, but there is no reason to fear ultimate failure. New uses will have to be worked out, perhaps with emphasis on the field of home cooking, but also with respect to utilization by institutions of all kinds. It appears that considerable attention should be given to the use of nonfat dry milk solids as an ingredient in a number of prepared foods, such as soups, sausage, cereals, and other foods. No doubt appropriate packages will have to be developed to meet the requirements of various types of consumers, including small packages for city housewives, suitable merchandising methods will have to be devised, and effective means of education in the value of this commodity remain to be evolved, in order to bring it to the attention of the people who can use it advantageously. As in other large undertakings, such efforts get under way slowly, but gather momentum as they go along.

In the circumstances, there are weighty arguments in favor of governmental assistance, perhaps on a decreasing scale year by year, to bridge the gap during the period while domestic consumption is catching up with the war stimulated production. If this can be arranged, there is good reason to believe that the output now urged as a war measure can be absorbed advantageously by domestic consumers not very long after the end of the war, with the result that the drying facilities can be continued in use and the farmers who shift to whole milk delivery will continue to have a market for their milk.

Tentative Estimates of Postwar Utilization

In connection with the uses which may be made of nonfat dry milk solids shortly after the end of the rehabilitation period in Europe, it may be helpful to have a detailed account of the quantities which, it seems probable, may be taken by the various users in the event that production at that time has been increased to 900,000,000 pounds per year. Such information is necessarily based upon estimates of future conditions.

On the assumption that the war in Europe will end in 1944, the estimates presented are suggested for 1947. It is recognized that the estimates are not equally valuable. Some contain a greater element of conjecture than others. In some instances, as in bread, data are available concerning the former utilization of nonfat dry milk solids; in other instances there is no definite information of past utilization on which to base appraisals of future takings. The estimates represent, however, the best opinion which the writer was able to obtain in the course of the study through the use of the available data and making inquiry of a limited number of persons in the respective fields.

The very tentative distribution of an estimated annual output of 900,000,000 pounds is suggested by the following figures:

	<u>Million pounds</u>
1. Baking industry	400
2. Institutions	75
3. Confectioners and chocolate makers	60
4. Armed forces	50
5. Ice cream	30
6. Household uses	25
7. Sausage	25
8. Soups and cereals	15
9. Chocolate milk and cultured buttermilk	15
10. Cake flour, pancake flour, etc.	10
11. Margarine manufacture	2
12. Direct distribution and export	<u>203</u>
Total	900

With respect to the baking industry, it may be noted that nearly 170,000,000 pounds of nonfat dry milk solids were used in it in 1939 by bakeries reporting to the Census of Manufactures, and trade estimates indicate that 200,000,000 pounds were used in 1941.

Although the 400,000,000 pounds suggested for 1947 is approximately double the largest quantity used by the baking industry thus far, it is smaller than the proportion advised by leading nutritional authorities. More than this amount would have been required in the white pan bread baked commercially in 1939 if 6 percent of nonfat

dry milk solids had been used in its manufacture, and it is known that substantial quantities are used in other bakery products.

The estimate of 50,000,000 pounds to be used by the confectioners and chocolate makers is conditioned to a large degree by the national income. It was estimated that more than 20,000,000 pounds of nonfat dry milk solids was so used in 1942, in spite of limited supplies in the last few months of that year. The estimate of 50,000,000 pounds for 1947 was based upon the expectation of a high national income, although somewhat below present levels.

The commercial production of ice cream also is related closely to the level of the national income and this estimate is based upon the assumption of a relatively high level. It is recognized that many manufacturers prefer fresh milk or condensed skim milk, but the compactness and convenience of nonfat dry milk solids are strong factors, particularly in deficit areas, with respect to dairy products.

With respect to the estimate of the quantity to be used in the manufacture of margarine, it should be stated that liquid skim milk is preferred if an adequate supply is available. In a number of instances, particularly in the South, shortages of skim milk force manufacturers to turn to nonfat dry milk solids.

In sausage manufacture, the addition of nonfat dry milk solids will add to the nutritive value of the product, but the cost will be somewhat higher than if cereal were added. Probably the lower grade sausages will use very little nonfat dry milk solids, but the higher grades may use a considerable quantity.

The amounts which will be used in institutional and home cooking are difficult to estimate, but it is reasonable to assume that these amounts will be substantial if supplies are available. This is true also of utilization in soups and cereals, and in chocolate milk and cultured buttermilk.

It is noticeable that a large proportion of the total is reserved for export and direct distribution. More detailed suggestions on this point will be included in the discussion of the measures necessary to obtain a substantial increase in the production of nonfat dry milk solids.

Costs of Program May Be Comparatively Small

Assuming that domestic consumption will increase rapidly in the postwar period and soon equal or exceed the proposed output of 850,000,000 pounds of nonfat dry milk solids, the costs of the increase in production will range from small to moderate. At most, they will be moderate in the event that foreign demand falls off

sharply, and considerable governmental assistance is necessary in handling part of the output while domestic consumption is catching up to the expanded production; they will be small if foreign demand drops off gradually, permitting domestic consumption to take up the slack without such assistance. In the latter event, the principal cost will be the expense involved in obtaining an increase in production of about 325,000,000 pounds in a comparatively short time over what it would cost if spread over a longer period. These costs should be only slightly higher than those which have been incurred in stimulating production in 1942 and 1943. In comparison with the costs of most commodities produced to meet emergency needs, those of an increased output of nonfat dry milk solids will be small.

A BROAD, COORDINATED PROGRAM IS ESSENTIAL
IN OBTAINING INCREASE

It has been pointed out in the foregoing sections that a number of factors have interfered with the production of nonfat dry milk solids. As things stand, production is decreasing. No one measure can correct all the difficulties advantageously. In order to reverse the downward trend and obtain a substantial increase in production, it is necessary to attack the problem on several fronts through a broad, well coordinated program.

Vigorous action is required because the increased supply will be needed this year and the next since, as was noted above, the peak needs for nonfat dry milk solids are likely to occur sometime in 1945 or 1946. In these circumstances, it is to be expected that greater pressure will be required to achieve the goal than if the increase in production could well be spread over several years, particularly since the cooperation of numerous plants and large numbers of their patrons must be obtained.

Restating the problem, it is evident that in order to achieve an annual output of approximately 850,000,000 pounds of nonfat dry milk solids, it will be necessary to divert about 4 billion pounds from farm separation to whole milk delivery. Even if the shifts are made principally in the areas of more intensive dairying, they probably will involve about 150,000 farmers, of whom most will be found in localities not now served by drying plants.

The major items included in a program necessary to reach this goal include:

1. Assurance of market for nonfat dry milk solids for several years
2. Premium for whole milk delivery (or higher prices for nonfat dry milk solids if feed subsidy should be discontinued)
3. Government funds for drying facilities (including farm cooling systems)
4. Publicity campaign showing need for powdered milk
5. Educational work (by State colleges) on substitutes for skim milk as feed
6. Price and other control of all manufactured dairy products and fluid cream
7. Aid in obtaining labor for drying plants

8. Organized redistribution of drying equipment
9. Decentralized purchasing and storing arrangements
10. Quality improvement program.

Assurance of a market for nonfat dry milk solids for several years after the close of the rehabilitation period should be given the creameries and farmers joining in the increased production of this commodity. A guarantee for a year or two is not sufficient to induce new plants to undertake drying, because at least several months ordinarily are required to get drying operations under way. Unless the margin of profit is wide, a period of several years may be required before the increased returns overbalance the costs involved. The assurance does not mean that prices must be maintained at the current level, but rather that a market for the commodity should be provided at prices not out of keeping with those of other dairy products, so that producers may know that they will not be forced to close down operations soon after the end of the war because of inability to find an outlet for their powder. In the absence of such assurance it will be necessary to offer sufficient inducements to persuade numerous small groups to take the risks of loss of a market separately; it is much more economical for the government to pool the risks of this type through providing a market. One way that this can be done is by arranging that a government agency shall purchase the output in excess of what domestic commercial demand can absorb and either sell the surplus abroad or dispose of it through direct distribution. Purchase of the surplus should be at a level commensurate with prices of other dairy products.

A premium on whole milk delivery is necessary on the basis of present prices, either in the form of a subsidy or of higher prices for nonfat dry milk solids, in order to facilitate a rapid shift from farm separation to the delivery of whole milk. At present (March, 1944) the feed subsidy has been changed to provide for from 50 to 80 cents per 100 pounds of milk and 8 cents per pound of butterfat. If the subsidy is continued, it would be possible to widen the differential, if this step becomes necessary, emphasizing in the announcement of the change that the differential was being paid in order to increase the quantities of whole milk solids used for human food. This step is suggested in order to make an impressive gesture toward whole milk delivery, thus facilitating a rapid conversion from cream sales to whole milk delivery.

If the feed subsidy should be discontinued, an advance in the prices of nonfat dry milk solids would be necessary if increased output is to be obtained. Further, an adjustment in prices of cheese, evaporated milk, etc., would be required also in that instance, lest butter and nonfat dry milk solids draw excessive quantities of milk away from those commodities.

In considering prices, it should be noted also that the prices of nonfat dry milk solids and of other manufactured dairy products

should be adjusted for seasonal variations. A flat price tends to cause production to be concentrated in the spring and summer, reversing the gradual trend toward more uniform production of milk throughout the year, which had resulted from the higher prices prevailing in the fall and winter.

"....It is well known that most farmers find it easier to produce milk in the summer than in the winter and that there is a natural tendency for their output to vary widely from season to season....If average prices were paid for all the milk that producers cared to deliver, a special stimulus would obviously be given to summer dairying...." (3)

While these remarks were directed to the production of fluid milk, they apply to production for manufacturing purposes as well. It should be borne in mind also that there is greater reason to desire comparatively uniform production of milk for the manufacture of butter and powder, particularly when expensive spray equipment is used, than was the case when butter was the only product.

Government funds should be employed to provide drying facilities in new localities where adequate supplies of milk can be obtained. Such funds already have been used in the erection of plants and the purchase of equipment. Consideration should be given also to the extension of this practice to the extent of aiding with other facilities. The use of such funds will decrease the total of other inducements necessary to obtain an adequate increase in the production of nonfat dry milk solids.

One use of such funds which may be particularly helpful may be in the form of grants to stimulate the erection of farm cooling tanks or other approved means of cooling milk on farms where butterfat has been sold. Even if such facilities have been provided for the cream, they are likely to be inadequate for the increase in volume represented by sales of milk. Lack of proper cooling equipment on the farms tends strongly to lower the quality of the milk received at the creameries, particularly when farm work is pressing, and thus to lower the quality of the powder. Grants of this sort, perhaps of \$30 per farm, should be made only while the expansion program is under way. Used in this manner, they will aid in persuading a comparatively large proportion of the patrons of the creameries newly turned to milk drying to shift promptly from farm separation to whole milk delivery, thus permitting the dryer to approach maximum capacity more quickly.

A publicity campaign, carried on principally in the areas where shifts from farm separation to whole milk delivery are most feasible, is highly desirable in setting forth the need for more nonfat dry milk solids and in persuading creameries and farmers to cooperate.

in providing it. Definite statements by leading officials concerning the need for the commodity and statements concerning the steps proposed in order to obtain it are essential, but in addition an intensive follow-up, keyed to the conditions of dairy farmers and plant operators in the respective areas, should not be overlooked. In this connection, the services of the college editors and of the Extension Services in the States involved should be especially helpful. No high-pressure salesmanship is advisable, but the facts concerning the need for nonfat dry milk solids and the willingness of the government to make commitments to obtain an adequate amount should be brought before those persons who will be called upon to decide whether or not to join in providing it.

Educational work in animal nutrition providing information concerning the best substitutes for skim milk as a feed should be pushed vigorously in the States where farmers turn from cream sales to whole milk deliveries. This action is necessary because many farmers do not know what nutrients are contained in the skim milk which they have been feeding to their calves, pigs and chickens. If they shift to whole milk deliveries, their young livestock are likely to make poor progress, perhaps even to the point that some farmers will revert to cream sales in order to have the skim milk. A vigorous educational campaign will point out the proteins, minerals, and vitamins which should be added to the ration for each class of livestock to replace the skim milk as far as possible.

Perhaps this work could best be handled by requesting the Animal Husbandry faculties and the Extension Services of the various States to conduct the needed campaigns. Attention should also be given to the need for increasing the legume acreage in those States in order to supply more vegetable proteins for animal feed.

Price control of other manufactured dairy products also is desirable. Production of nonfat dry milk solids was reduced seriously in 1943 because a number of competing products could be sold at prices substantially higher than those commanded by nonfat dry milk solids and also because such products were not affected by "set aside" orders. This situation will be corrected in part by Food Distribution Order No. 93 of the War Food Administration, which became effective March 1, but it would be helpful if specific price ceilings were imposed upon the competing products as well.

Food Distribution Order No. 93 provides for control of the production of dried whole milk and dried milk products and compounds through restrictions on sales and inventories. It does not deal with the diversion of skim milk from nonfat dry milk solids to the more profitable condensed skim milk (see p.9), but that diversion has been of minor consequence.

Imposition of specific price ceilings upon all dairy products would help increase the production of nonfat dry milk solids through

removal of the temptation to turn to more profitable products. For this reason, the imposition of such ceilings would facilitate the administration of Food Distribution Order No. 95. Further, it may be noted that the comparatively high prices received in some instances for defatted milk solids for animal feed tend to decrease the incentive for the plants producing such solids to shift to the more costly production of food. Effective ceilings upon the feed product would contribute to a greater shift to the production of defatted dry milk solids for human food.

Aid in labor matters should be given to drying plants. Available evidence indicates that this may fall under two main heads. One consists of representations to the War Manpower Commission concerning the need for wage adjustments in drying plants which are not able to obtain sufficient labor for full operation because of the competition of war plants. The evidence here admittedly is scanty but it appears that the possibility of effecting some improvement should not be overlooked. It will be unfortunate if it is necessary to erect new plants and persuade farmers to turn to whole milk delivery in order to produce some nonfat dry milk solids which could be produced with existing facilities if additional labor were available.

In the second place, the importance of men skilled in milk drying should be brought more clearly before Selective Service officials. It is understood that deferments for such employees have been difficult to obtain and that drying operations in some places already have been handicapped seriously by the lack of trained men. In view of the fact that the commodity is urgently needed and that the skill of one man may be important to a large number of farmers whose milk he processes, it would seem that a valid claim to occupational deferment could be defended in many instances.

More intensive use of drying equipment is highly desirable. It appears that a considerable amount of equipment for milk powdering now is situated in areas where it is not being used because no skim milk is available for drying. This is true particularly in metropolitan milksheds where the increased demand for fluid milk has greatly reduced the surplus formerly available for powdering, condensing, or evaporating. In some milksheds, too, the increased demand for fluid milk has left very little to be skimmed for fluid cream, so that less skim milk is available from that source.

Because of the shortage of critical materials, it is desirable that intensive efforts be made to move idle equipment, where practicable, to areas where skim milk can be made available rather than to attempt to manufacture all the additional equipment needed. Some progress has been made in this direction, but it is believed that an organized effort would obtain good results, particularly with respect to roller equipment. It is recognized that spray process equipment is more difficult to move.

Consideration may be given to the organization of an agency to purchase such idle equipment and sell it to groups which can put it to use. It should be borne in mind that the concerns which have such equipment will be able to purchase new and improved equipment at a later date when they are again in a position to make use of it. Adequate consideration, of course, should be given to the possibility of higher prices for equipment in the post-war period.

Some roller process equipment, however, is held in reserve against flush periods. One example of this type is that of a Wisconsin creamery which had shut down its dryer in the fall of 1943 and was selling its skim milk to a nearby spray plant which was paying more than this creamery could realize from its sale of roller powder. Though this situation prevailed while production was small, it was desired to retain the equipment because indications were that the spray plant would not be able to purchase milk when production should become heavier. Allowance must be made for such conditions.

The possibility of increasing output through the installation of pre-heating and pre-condensing equipment should not be overlooked in areas where supplies of milk are in excess of drying capacity.(10) In a number of instances such equipment may permit a material enlargement of the quantity dried. In some roller plants, it may be possible to install another roller unit, provided that the boiler capacity is equal to the added load. In some areas where there has been a considerable shift to whole milk delivery, the creamery managers have exercised caution in taking on new patrons in the spring, lest they should be unable to handle all the milk during the flush season.

Perhaps further pressure could be used to advantage to cause conversion from the production of nonfat dry milk solids for feed to production for human food, but this point requires further investigation. Some nonfat dry milk solids for feed is necessary in the production of calf meal, poultry feed, etc., which is much needed for use in localities delivering whole milk to creameries and other milk plants. Perhaps this matter could be handled more conveniently by the imposition of price ceilings upon nonfat dry milk solids for feed. (See above, pp. 46-47)

Consideration should be given also to the possibility of converting some egg powdering plants into milk drying plants in the event that fewer dried eggs should be required in 1944, and especially in 1945. It is recognized that milk receiving, cooling and handling equipment will have to be added and the expense may be increased if the buildings have not been designed with an eye to this contingency, but a number of such plants may be utilized to advantage if adequate supplies of milk are available. In some instances, it may be desirable to transfer the equipment to areas where milk can be obtained.

Decentralization of purchasing and shipping arrangements is desirable because some of the smaller creameries producing dried skim milk experience difficulty in dealing at a distance with Washington officials. Many of them have been accustomed to turn over most of the problems in the marketing of butter to the wholesalers with whom they trade. In part for this reason, they have found it difficult to deal at a distance with authorities in Washington in selling their nonfat dry milk solids to the Office of Distribution.

Another difficulty has been inability to obtain shipping instructions after the nonfat dry milk solids had been accepted. Many of the smaller creameries do not have a great deal of warehouse space and thus are not in position to handle a large accumulation of nonfat dry milk solids in addition to the empty barrels which they have to keep on hand.

Regionalization of purchasing and warehousing arrangements for nonfat dry milk solids would bring the persons in charge much closer to the producers of this commodity and would permit greater flexibility in the purchasing and shipping.

The above suggestions, of course, do not contemplate any reduction in the services now being rendered by the Dairy and Poultry Branch to creameries and others interested in the production of nonfat dry milk solids. On the contrary, it is evident that the scope of such services will have to be increased if numerous creameries and large numbers of farmers are to enter the new field of milk drying. Perhaps additional consideration should be given, however, to the possibility of transferring more administrative control of such activities to the areas where they are most in demand.

A quality improvement program should be developed, because the increase in the number of plants producing nonfat dry milk solids and the delivery of whole milk by farmers accustomed to farm separation will tend to lower the average quality of nonfat dry milk solids. With the present shortage of supplies, the poorer lots are penalized less severely than they would be if supplies were adequate, but it is apparent that poor quality is likely to create an unfavorable impression of the commodity among current users, which will retard consumer acceptance after the end of the war. Further, the plants which produce comparatively poor powder will face serious difficulties in selling their product when supplies become more abundant.

Some lowering of quality already has been apparent as a result of the new localities included up to the end of 1943. If a substantial increase in nonfat dry milk solids is to be obtained in 1944 and 1945 through the extension of whole milk deliveries into butter territory, the average quality is likely to show a further drop unless measures are adopted to reinforce the efforts now being made by various agencies to secure improvement.

Quality improvement programs have been pushed by some of the larger organizations but the principal effects of such programs are restricted to their patrons. A considerable amount of work, in the aggregate, has been directed toward improvements in milk quality by the Bureau of Dairy Industry and by the Dairy Departments and the Extension Services of the agricultural colleges in the States in which dairying is important, but this work should be expanded to keep pace with the increased importance of nonfat dry milk solids.

Steps to improve the quality of nonfat dry milk solids should be taken by the War Food Administration as part of its dried milk program, reinforcing and coordinating the work of the other public agencies in this direction. The War Food Administration has some responsibility for quality since it stimulated the expansion which has tended toward a reduction in the average quality; it stands to gain by raising the quality of the nonfat dry milk solids offered to it; and higher quality will reduce the need for governmental assistance in the market after the end of the war.

This work would fall into two main divisions -- research and educational work. Probably the research work should be apportioned between the Bureau of Dairy Industry and the appropriate agricultural colleges. It should include a systematic study of milk handling upon the farms, in transit to the plants and within the plants, as well as of the drying processes and of the factors affecting nutritive values, the palatability, and the keeping qualities of nonfat dry milk solids. Considerable attention should be given also to the development of improved tests of the quality of nonfat dry milk solids and to tracing the effects of variations in the production and handling of milk upon that quality. Much information bearing upon these subjects is now available and it should be brought together and supplemented by additional studies. It should be directed toward the end of permitting variations in quality to be reflected accurately through price differences to the plants producing the nonfat dry milk solids and to the farmers sending milk of varying quality to the drying plants.

The educational work at the outset would be devoted primarily to adapting information already at hand concerning milk handling to the use of plant managers and employees as well as to farmers. Later, it should include increasing proportions of the information being developed in the research program. Such work should be done, of course, in cooperation with the existing agencies, coordinating and reinforcing their efforts.

MOST OF NEW DRYING EQUIPMENT SHOULD BE OF ROLLER TYPE

Since the peak need for nonfat dry milk solids may occur in 1945, it is evident that whatever increase in nonfat dry milk solids production is to be obtained should be gotten quickly. Largely for this reason, it is believed both that most of the new drying equipment still to be arranged for and installed should be of the roller type and a major part of the increased output should be of roller process powder. Some additional spray process plants doubtless should be erected in appropriate places, but conditions in most localities which have yet to shift from farm separation to whole milk delivery will favor the roller process type.

The use of roller type equipment in localities new to milk drying is in accordance with the usual course of events of this type in other communities.

Historically, the evolution of types of equipment in the experience of many plants in the Middle West has been from the roller process type to the spray process type. Frequently the first experience of a creamery pioneering in this field has been with a small roller which was used to dry buttermilk and some skim milk for feed. Then sometime when the market for nonfat dry milk solids for food was active, the shift to the production of food was made. Presently, a larger roller was needed, then another, and sometimes a third or a fourth. Then when a large supply of skim milk for drying had been built up, the creamery was in a position to undertake the installation of spray process equipment in order to obtain the higher prices which that powder commands.

Roller Equipment is Better Suited to Many New Localities

Two major factors in choosing between roller and spray process equipment are the peak supply of milk available for drying in the flush season and the seasonal variations in the supply. If the peak supply of milk is comparatively small and if the amount falls off sharply after the flush season, it is probable that rollers will be preferable, assuming that the supply is large enough to justify any drying equipment.

Since the initial investment for a plant of given capacity is much greater in spray equipment than in roller equipment, it is evident that with spray equipment it is important to have a supply of milk sufficient to maintain drying at full volume throughout nearly all the year. Another item to be considered is the difference between a large plant equipped with roller and one with spray equipment. The roller process plant may have as many as four roller units and can shut down one, two or three of them during the slack period, thereby reducing the costs and increasing the

flexibility of its operations. A spray process plant having two units may shut down one of them if supplies of milk are short, but a plant having only one spray unit would be forced to operate fewer hours under such conditions, thus increasing the cost per pound through greater proportional expenses for preparing to dry and for cleaning the equipment as well as for such things as depreciation, interest and insurance.

Some well established plants have come to handle the problem of peak supplies of milk through the addition of roller equipment to their spray drying equipment, operating the roller units only during the flush season. In this way, they are able to keep the spray process equipment going at rather a high rate during nearly all the year.

Obviously, few localities where milk drying equipment is being newly installed will be in a position to handle both types of equipment. In such localities it is likely that the seasonality of milk production will be greater than the average for the United States and for this reason also, roller process equipment is preferable for most of them.

Of course, it is possible for a creamery having only a moderate quantity of skim milk for drying to install a spray dryer and to arrange to purchase whole milk or skim milk from other creameries in order to have adequate supplies for full operation. Such a course, however, involves the assumption of greater risks than are justified in many instances. It is believed that purchases of this type are more difficult to effect in the areas where conversion to whole milk delivery is beginning than in those where it is the accepted practice. This circumstance also favors a greater use of roller equipment in the newer localities.

It is possible also to bring together enough milk to warrant the installation of spray equipment through the federation of a number of creameries which individually would not have enough milk for that purpose. Such arrangements, however, are much easier to effect if the creameries already have been accustomed to act as a group in other matters. More time would be required to promote the organization of such a group and to obtain spray equipment than for individual creameries to install roller equipment. Even though a number of creameries in an area may be willing to join in such an effort, it is likely that some others may require a great deal of persuasion or may be entirely unwilling.

There is a possibility also that the existing laws in each State may not be so framed as to facilitate the federation of a group of creameries for the purpose of manufacturing and selling nonfat dry milk solids. No definite information is available of any difficulty arising on this point, but it is one which should be considered.

In view of these circumstances, it is evident that increased production of nonfat dry milk solids can be obtained more quickly in many localities where farm separation is now practiced through the use of roller equipment than of spray process equipment. Largely for this reason it is urged that the installation of roller equipment be pushed vigorously.

Additional spray process equipment should be installed in localities which can utilize this equipment to advantage. Where volume of milk to be dried, the seasonality of milk production, and other conditions are favorable, the spray process affords a more efficient means of marketing the skim milk than does the roller process, because the spray process powder is more desirable for many purposes and commands a higher price per pound.

More Roller Powder Can Be Used Advantageously

Obviously, much more roller process nonfat dry milk solids could be used to advantage, both at home and abroad, if it could be obtained. Indications are that substantial quantities of it can be utilized to advantage in this country in post-war years at a moderate differential under the prices of spray process powder. It is possible that foreign demand for it in post-war years will be highly sensitive to price and that a large proportion of our exports will consist of roller powder if it is only slightly cheaper than the spray process powder.

The principal domestic outlets for roller process nonfat dry milk solids in the United States when supplies again are relatively abundant seem likely to be:

1. Confectionery
2. Sausage
3. Part of baking industry
4. Institutional cooking
5. Mass feeding - floods, great fires, and other catastrophes.

In general it appears that confectioners will not pay any premium for spray powder over roller process powder and it does not appear that sausage manufacturers as a class will pay more than a very slight premium. The question of spray versus roller powder for bread baking is controversial, but the indications are that many bakers will not be willing to pay much more for spray process than for good roller process powder. For some uses in cooking in institutional kitchens (hospitals, restaurants, dormitories, prisons, etc.), such as soup, meat loaf or biscuits, the roller process powder may be as desirable as the spray process nonfat dry milk solids.

There is reason to believe that these uses will be able to absorb a considerable proportion of the roller process nonfat dry milk solids likely to be produced in the immediate post-war period, so that an undue proportion will not have to be pressed for export at that time. Even a premium of 1/2 cent or 3/4 cent for spray process powder is likely to tip the balance of demand toward the roller process for some uses.

For other uses, however, the spray process powder will be preferred, when supplies are more plentiful, even at a considerable premium. The principal ones are:

1. Reconstitution as fluid skim milk
2. Most ice cream
3. Chocolate making
4. Icings
5. Certain kinds of cakes
6. Chocolate milk, cultured buttermilk, etc.
7. Margarine manufacture
8. Household packages
9. Infant food

Turning to the matter of foreign needs, it is apparent that more roller process nonfat dry milk solids could be used to advantage for Lend-Lease purposes at the present time. Late in 1943 it was reported in Parliament that British millers now are required to incorporate three-fourths of one percent of nonfat dry milk solids in their bread. (15) This proportion is very small and more roller process powder could be used to advantage there.

No definite evidence is at hand concerning the probable foreign demand for roller process powder after the rehabilitation period, but here it is reasonable to assume that when importing countries come to finance their own purchases, the prices of the commodities bought will be scrutinized very closely. In such circumstances, many buyers are likely to prefer the roller process powder even if prices are only slightly lower than those of spray process powder.

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APPENDIX TABLES

Table 1 - Total supply and utilization of milk in the United States in selected years

	1942	9/	1940	1935	1930	1925	1920
In millions of pounds							
Milk production							
By cows on farms	119,240		109,510	101,205	100,158	88,375	-
By cows not on farms	1/ 2,826		1/ 2,826	1/ 2,826	2,826	4,241	-
Total	122,066		112,336	104,031	102,984	92,616	89,657
Utilization, (milk equivalent)							
Manufactured in plants							
Creamery butter, net 2/	35,662		36,801	32,665	32,162	29,242	18,135
Cheese, total	11,198		7,862	6,237	5,061	5,002	3,624
American	9,270		6,115	4,813	3,904	6/	-
Other	1,928		1,747	1,424	1,157	6/	-
Evaporated and condensed milk							3,945
Evaporated milk (case)	7,655		5,266	3,947	3,113	2,585	-
Unsweetened condensed (bulk)	278		312	250	312	277	-
Sweetened condensed (case)	180		137	117	267	411	-
Sweetened condensed (bulk)	181		165	80	136	97	-
Dried whole milk	455		223	156	118	68	83
Other dried products 3/	63		54	43	68	55	49
Ice cream, net 4/	5,312		3,730	2,343	2,880	2,551	3,575
Total factory products	60,984		54,550	45,838	44,117	40,288	29,411
Used for farm butter	7,290		8,129	10,931	10,629	11,449	14,175
Consumed as milk or cream							7/39,156
In cities, villages, etc.	37,650		33,519	30,564	32,066	28,760	-
On farms where produced	11,783		12,072	12,410	11,210	6/	-
Fed to calves	3,290		2,995	2,676	2,986	2,262	4,202
Other uses	5/1,069		5/1,071	5/1,612	5/1,976	6/	8/2,713

1/ Assumed to be the same as 1930. 2/ Excludes milk equivalent of whey butter. 3/ Includes dried cream and malted milk. 4/ Excludes milk duplicated in butter and condensed milk. 5/ Residual, including other uses and inaccuracies of independently derived use estimates. 6/ Not available. 7/ Includes milk used for household purposes, in chocolate milk, and in canned sterilized milk. 8/ Waste, loss and unspecified. 9/ Preliminary.

Source: 1942, 1940, 1935 - Farm Production, Disposition, and Income from Milk, 1941-42, and Miscellaneous Dairy Statistics, 1942. Bureau of Agricultural Economics, April, 1943.

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Table 2 - Milk: Production on farms, milk equivalent of farm churnings and sales of butterfat, and deliveries to wholesale plants by years, United States, 1924-42

Year	Milk production	Milk sold as butterfat or utilized in farm churnings	Milk delivered wholesale to plants, dealers, etc.
<u>In millions of pounds</u>			
1924	89,240	42,611	25,907
1925	90,699	43,153	26,830
1926	93,325	44,857	27,707
1927	95,172	45,792	28,600
1928	95,843	44,607	30,367
1929	98,988	44,854	33,347
1930	100,158	44,621	34,497
1931	103,029	46,529	34,614
1932	103,810	47,915	33,501
1933	104,762	48,322	33,705
1934	101,621	45,210	33,869
1935	101,205	43,495	35,647
1936	102,410	42,067	38,777
1937	101,908	40,192	40,470
1938	105,807	41,901	42,657
1939	106,792	41,640	43,801
1940	109,510	41,186	47,166
1941	115,498	42,193	52,219
1942 ^{1/}	119,240	39,163	59,192
1943			
1944			
1945			

^{1/} Preliminary

Source: Farm Production, Disposition and Income from Milk, 1941-42 and Miscellaneous Dairy Statistics, 1942. Bureau of Agricultural Economics, April 1943

Table 3 - Milk: Production on Farms in the Midwest Region, by States, 1935-42

State	1935	1936	1937	1938	1939	1940	1941	1942	1/
	In millions of pounds								
Illinois	4,873	4,814	4,873	4,988	5,053	5,188	5,453	5,522	
Indiana	3,049	3,013	2,944	3,139	3,180	3,225	3,435	3,539	
Iowa	6,009	6,052	5,919	6,338	6,379	6,611	6,920	6,941	
Michigan	4,257	4,465	4,470	4,560	4,762	4,949	5,124	5,296	
Minnesota	7,384	7,745	7,646	8,175	8,160	8,405	8,824	9,090	
Missouri	3,363	3,014	3,053	3,270	3,271	3,386	3,631	3,816	
Nebraska	2,689	2,623	2,356	2,479	2,618	2,589	2,752	2,969	
North Dakota	1,951	1,919	1,796	1,821	1,906	2,115	2,284	2,325	
Ohio	4,356	4,389	4,434	4,522	4,570	4,617	4,838	5,037	
South Dakota	1,603	1,640	1,472	1,570	1,642	1,746	1,827	1,867	
Wisconsin	10,921	11,598	11,378	11,862	11,973	12,665	13,625	14,239	
Midwest Region	50,455	51,272	50,341	52,724	53,514	55,496	58,713	60,641	
United States	101,205	102,355	101,898	105,588	106,792	109,510	115,498	119,240	
1/ Preliminary									

Source: 1935-40 - Agricultural Statistics, 1942. U. S. Department of Agriculture
 1941-42 - Farm Production, Disposition and Income from Milk, 1941-42 and Miscellaneous Dairy
 Statistics, 1942. Bureau of Agricultural Economics, April 1943

Table 4 - Cream sales and whole milk deliveries to wholesale plants in the Midwest Region, by States, 1935-42

Year	ILLINOIS	INDIANA	IOWA	MICHIGAN	MINNESOTA	MISSOURI	NEBRASKA	NO. DAKOTA	OHIO	SO. DAKOTA	WISCONSIN	MIDWEST REGION												
	: Whole :	: Whole :	: Whole :	: Whole :	: Whole :	: Whole :	: Whole :	: Whole :	: Whole :	: Whole :	: Whole :	: Whole :												
: Cream:milk :	: Cream:milk :	: Cream:milk :	: Cream:milk :	: Cream:milk :	: Cream:milk :	: Cream:milk :	: Cream:milk :	: Cream:milk :	: Cream:milk :	: Cream:milk :	: Cream:milk :	: Cream : milk												
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	In millions of pounds																							
1935	1,405	2,112	1,120	1,075	4,344	476	1,506	1,658	5,504	702	1,676	450	1,633	220	1,290	41	1,160	1,882	1,088	39	2,535	7,225	23,261	15,880
1936	1,240	2,264	981	1,242	4,327	611	1,477	1,897	5,746	856	1,346	512	1,582	253	1,297	46	1,082	2,069	1,158	48	2,558	7,877	22,794	17,675
1937	1,195	2,434	925	1,262	4,206	639	1,412	2,022	5,560	978	1,350	597	1,413	225	1,207	44	958	2,290	1,021	49	2,182	8,085	21,429	18,625
1938	1,288	2,553	1,010	1,406	4,660	667	1,430	2,124	5,982	1,093	1,497	666	1,533	239	1,244	46	938	2,434	1,119	55	2,195	8,547	22,896	19,830
1939	1,280	2,620	956	1,513	4,694	691	1,510	2,279	6,002	1,097	1,445	732	1,677	240	1,341	41	940	2,492	1,187	57	2,224	8,610	23,256	20,372
1940	1,297	2,775	898	1,638	4,907	717	1,549	2,449	6,140	1,213	1,402	919	1,695	235	1,553	43	883	2,632	1,294	59	1,945	9,591	23,563	22,271
1941	1,320	3,063	860	1,905	5,182	763	1,460	2,718	6,353	1,450	1,468	1,117	1,846	247	1,727	50	820	2,929	1,378	66	1,660	10,828	24,074	25,136
1942	1,100	3,372	650	2,233	5,117	855	1,180	3,194	6,244	1,877	1,400	1,410	2,027	295	1,780	60	660	3,337	1,412	83	700	12,397	22,270	29,113
1943																								
1944																								
1945																								

1/ Preliminary

Source: 1935-1939 - Farm Production, Disposition, and Income from Milk, 1935-39. Bureau of Agricultural Economics, April, 1942
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Table 5 - Nonfat dry milk solids for human food: Production, by months, United States, 1935-45; average 1935-39

Year :	Jan. :	Feb. :	Mar. :	Apr. :	May :	June :	July :	Aug. :	Sept. :	Oct. :	Nov. :	Dec. :	Total
In thousands of pounds													
1935	11,854	11,795	15,232	17,272	22,723	24,100	17,570	16,899	15,364	13,015	9,902	11,805	187,531
1936	13,319	13,410	16,601	19,542	25,165	27,266	19,124	17,019	18,448	19,822	16,129	17,982	223,827
1937	18,495	15,790	19,671	22,211	28,848	29,611	24,442	19,635	17,646	16,049	13,731	18,382	244,511
1938	20,327	18,724	23,455	27,580	34,555	32,482	27,621	23,212	22,762	22,548	17,154	18,701	289,121
1939	20,108	18,401	22,502	24,048	30,666	31,489	24,360	20,260	18,848	18,013	18,041	21,124	267,860
1940	24,495	23,370	27,442	29,036	35,358	38,578	31,094	26,631	22,157	22,564	19,030	22,088	321,843
1941	25,714	25,715	31,142	34,449	43,781	41,780	31,953	29,293	27,016	25,253	22,816	27,543	366,455
1942	33,900	36,198	47,429	54,868	71,617	68,846	58,696	52,999	43,646	36,664	28,622	31,929	565,414
1943 ^{1/}	27,399	28,169	39,271	44,306	57,142	63,675	53,650	42,350	33,250	23,850	17,675	23,020	453,757
1944													
1945													
1935-39 average	16,821	15,624	19,492	22,131	28,391	28,990	22,623	19,405	18,614	17,389	14,991	17,599	242,570

^{1/} Estimated

Source: 1935-1940 - Agricultural Statistics, 1942. United States Department of Agriculture
1941 - Production by States of All Manufactured Dairy Products, 1941. Bureau of Agricultural Economics, January 1943
1942 - Production of Manufactured Dairy Products, 1942. Bureau of Agricultural Economics, February 1944
1943 - Monthly Evaporated, Condensed, and Dried Milk Reports. Bureau of Agricultural Economics

Table 6 - Nonfat dry milk solids for animal feed: Production, by months, United States, 1935-43; Average 1935-39

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
In thousands of pounds													
1935	6,235	6,200	7,420	9,927	14,453	15,710	12,836	10,315	9,356	7,145	4,470	5,908	109,975
1936	7,445	7,450	9,504	11,447	14,872	16,002	12,530	9,895	10,008	9,867	7,883	8,820	125,723
1937	9,773	9,907	13,029	13,584	17,580	16,120	11,804	8,254	8,105	6,820	5,469	7,247	127,692
1938	10,573	12,361	15,716	17,437	21,010	20,293	15,470	10,781	10,749	8,919	7,493	9,368	160,170
1939	11,011	10,445	12,844	14,943	18,929	17,316	12,543	8,799	8,660	7,947	7,126	9,957	140,520
1940	10,931	11,148	14,987	17,776	20,585	19,664	13,705	11,935	10,685	10,556	8,462	9,528	159,962
1941	9,800	9,349	12,331	13,774	15,835	14,363	9,824	7,620	5,987	3,930	3,500	3,729	110,042
1942	4,462	4,683	6,199	6,939	8,158	7,567	6,359	5,396	3,625	3,072	2,387	2,301	61,148
1943	1,917	2,713	2,229	2,634	3,016	3,400	2,350	1,750	1,400	915	825	975	24,124
1944													
1945													
1935-39 average	9,007	9,272	11,702	13,468	17,369	17,088	13,037	9,609	9,376	8,140	6,488	8,260	132,816

1/ Estimated

Source: 1935-40 - Agricultural Statistics, 1942. United States Department of Agriculture. These figures were obtained by subtracting the production for human food from the total production.

1941 - Production by States of All Manufactured Dairy Products, 1941. Bureau of Agricultural Economics, January 1943

1942 - Production of Manufactured Dairy Products, 1942. Bureau of Agricultural Economics, February 1944

1943 - Monthly Evaporated, Condensed, and Dried Milk Reports. Bureau of Agricultural Economics.

Table 7 - Dried whole milk: Production, by months, United States, 1935-43; Average 1935-39

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
In thousands of pounds													
1935	1,268	1,248	1,572	1,549	1,869	2,314	1,633	1,920	2,057	1,693	1,391	918	19,432
1936	752	843	1,171	1,316	2,522	2,872	1,850	1,664	1,479	1,559	1,134	1,018	18,180
1937	824	538	915	939	991	1,452	1,144	849	1,789	1,824	1,151	1,260	13,676
1938	1,202	1,393	1,661	1,458	1,974	2,373	3,302	2,464	2,114	1,423	1,707	1,425	21,496
1939	1,167	1,243	1,975	1,902	2,411	2,570	2,133	1,908	2,412	2,328	2,086	2,337	24,472
1940	2,047	1,257	2,048	2,260	3,706	3,630	3,752	2,143	1,883	2,273	2,216	2,194	29,409
1941	3,126	3,175	3,933	3,726	4,070	4,294	3,749	4,196	3,170	4,583	3,265	4,340	45,627
1942	4,080	2,678	4,697	4,409	4,739	5,871	5,624	5,425	6,238	6,821	4,488	7,097	62,167
1943 ^{1/}	8,050	7,850	11,250	11,950	13,750	14,500	12,200	9,125	9,450	8,975	7,500	9,650	124,250
1944													
1945													
1935-39 average	1,043	1,053	1,459	1,433	1,953	2,316	2,012	1,761	1,770	1,765	1,494	1,392	19,451

^{1/} Estimated

Source: 1935-1940 - Agricultural Statistics, 1942. United States Department of Agriculture
 1941 - Production by States of All Manufactured Dairy Products, 1941. Bureau of Agricultural Economics, January 1943
 1942 - Production of Manufactured Dairy Products, 1942. Bureau of Agricultural Economics, February 1944
 1943 - Monthly Evaporated, Condensed, and Dried Milk Reports. Bureau of Agricultural Economics

Table 8 - Casein, dried: Production, by months, United States, 1935-1943; Average 1935-39

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
In thousands of pounds													
1935	2,414	2,275	3,000	3,677	4,582	5,321	4,315	3,390	2,808	2,288	1,733	1,835	37,638
1936	2,186	2,621	3,583	4,916	5,721	5,975	4,717	3,699	3,550	3,356	2,773	3,013	46,140
1937	4,244	4,182	6,618	7,423	8,822	10,077	6,987	5,035	4,294	3,736	2,853	3,196	67,467
1938	3,143	2,720	3,385	4,384	6,234	5,986	4,437	4,247	4,775	3,670	2,876	2,692	48,549
1939	2,774	2,714	3,668	4,178	5,120	5,011	3,550	2,832	2,678	3,139	2,561	2,623	40,878
1940	2,712	2,921	3,865	4,818	5,486	6,336	4,825	3,631	3,354	2,962	2,601	3,105	46,616
1941	3,373	3,400	3,995	4,682	6,075	6,175	4,630	3,912	3,412	2,890	2,317	2,485	47,346
1942	3,040	3,451	4,470	4,979	6,824	6,317	4,022	3,042	2,267	1,693	1,098	1,065	42,268
1943 ^{1/}	1,070	1,260	1,540	2,230	2,935	4,040	2,556	1,734	1,088	1,321	493	520	20,787
1944													
1945													
1935-39 average	2,952	2,908	4,051	4,916	6,096	6,474	4,801	3,840	3,621	3,238	2,559	2,678	48,134

^{1/} Estimated

Source: 1935 - Bureau of Agricultural Economics (Chicago office)
 1936-1940 - Bureau of Agricultural Economics, quoted in Wisconsin Dairying, Supplement No. 1 to Bulletin No. 200, Wisconsin Crop Reporting Service, August 1942
 1941 - Production by States of All Manufactured Dairy Products, 1941. Bureau of Agricultural Economics, January 1943
 1942 - Production of Manufactured Dairy Products, 1942. Bureau of Agricultural Economics, February 1944
 1943 - Monthly Dried Casein Reports. Bureau of Agricultural Economics

Table 9 - Creamery butter (including whey butter): Production, by months, United States, 1935-43; Average 1935-39

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
In thousands of pounds													
1935	106,056	100,512	110,166	129,482	179,879	199,696	184,161	159,285	141,786	119,748	96,462	105,147	1,632,380
1936	110,666	108,744	121,543	133,290	177,847	190,699	156,463	141,556	133,021	135,493	111,535	108,550	1,623,407
1937	107,957	102,963	121,074	131,396	181,700	198,191	171,687	147,069	128,266	118,878	103,242	111,548	1,623,971
1938	116,122	112,340	128,735	147,628	197,259	202,528	185,099	168,688	151,081	136,999	116,841	122,852	1,786,172
1939	130,671	124,650	142,550	147,525	197,089	202,549	182,151	167,038	133,755	123,243	112,251	118,265	1,731,737
1940	129,558	128,143	140,730	153,628	195,332	206,555	187,687	167,704	146,247	136,812	117,783	126,647	1,836,826
1941	135,143	129,804	147,507	162,490	214,206	210,250	194,611	168,787	146,430	133,695	112,566	116,694	1,872,183
1942	119,685	116,963	134,976	147,857	200,313	202,159	187,494	168,210	138,300	124,770	106,548	116,779	1,764,054
1/1943	122,880	121,995	140,075	150,185	190,535	202,195	181,335	151,880	126,485	107,645	92,965	97,650	1,685,825
1944													
1945													
1935-39													
Average	114,294	109,842	124,814	137,864	186,755	198,733	175,912	156,727	137,582	126,872	108,066	113,272	1,690,733

1/ Estimated

Source: 1935-1940 - Agricultural Statistics, 1942. United States Department of Agriculture
 1941 - Production by States of All Manufactured Dairy Products, 1941. Bureau of Agricultural Economics, January 1943
 1942 - Production of Manufactured Dairy Products, 1942. Bureau of Agricultural Economics, February 1944
 1943 - Monthly Creamery Butter and Cheese Production Estimates. Bureau of Agricultural Economics

Table 10 - Cheese, Whole-Milk, American Cheddar: Production in factories,
by months, United States, 1935-43; Average 1935-39

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
In thousands of pounds													
1935	22,197	21,919	26,914	32,825	48,926	60,560	55,238	53,101	49,053	42,114	28,811	27,341	468,999
1936	28,881	26,211	30,804	35,324	53,008	64,145	51,029	45,228	44,933	45,629	33,088	29,296	487,576
1937	28,515	27,765	32,262	39,061	56,268	64,454	55,706	48,824	42,701	38,875	30,209	27,401	492,041
1938	30,535	30,670	38,884	48,469	70,263	74,363	65,881	55,682	44,277	43,069	30,173	28,276	560,542
1939	29,575	28,900	36,311	43,649	62,189	70,739	61,884	54,895	46,046	40,687	31,662	30,761	537,298
1940	32,280	33,945	41,704	48,996	67,702	77,343	68,321	59,776	53,460	47,923	36,073	35,267	602,790
1941	38,329	37,830	47,086	56,155	81,960	85,022	78,050	75,972	70,824	66,996	56,347	58,551	753,122
1942	62,292	63,939	78,049	91,670	119,919	112,734	96,419	85,243	67,523	56,492	41,851	40,719	916,850
1943	46,545	46,945	58,035	66,740	87,560	97,600	87,340	77,185	65,950	54,560	41,340	41,610	771,410
1944													
1945													
1935-39 average	27,941	27,093	33,035	39,865	58,131	66,852	57,947	51,546	45,402	42,075	30,789	28,615	509,291

1/ Estimated

Source: 1935-1940 - Agricultural Statistics, 1942. United States Department of Agriculture
1941 - Production by States of All Manufactured Dairy Products, 1941. Bureau of Agricultural
Economics, January 1943
1942 - Production of Manufactured Dairy Products, 1942. Bureau of Agricultural Economics,
February 1944
1943 - Monthly Creamery Butter and Cheese Production Estimates. Bureau of Agricultural Economics

Table 11 - Milk, evaporated, unsweetened, unskimmed, case goods: Production, by months, United States, 1935-43; average 1935-39

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
In thousands of pounds													
1935	113,393	121,134	146,500	177,264	236,512	252,831	202,274	160,522	134,809	105,710	86,337	101,604	1,838,890
1936	117,253	113,951	148,174	178,657	235,361	254,858	200,279	181,209	184,136	186,141	129,736	114,004	2,043,759
1937	119,152	126,509	153,290	184,829	239,156	252,535	205,752	162,506	138,376	124,126	92,322	104,012	1,902,545
1938	127,302	131,765	171,440	203,249	285,673	278,601	227,443	185,808	151,122	125,000	102,056	114,739	2,104,198
1939	131,320	139,717	179,848	203,867	263,215	263,840	226,600	190,902	158,271	144,568	123,694	139,759	2,170,601
1940	158,221	171,137	201,296	225,619	273,838	293,219	259,235	230,391	198,809	172,641	134,254	148,607	2,467,267
1941	172,262	169,493	208,296	254,215	354,803	350,063	310,791	307,855	290,634	281,683	259,768	286,684	3,246,547
1942	314,920	304,804	340,999	361,154	445,605	397,567	314,349	270,024	221,679	203,114	165,956	178,333	3,518,504
1943	1/204,698	210,315	252,339	288,923	376,015	386,000	335,500	275,500	232,763	188,896	155,999	168,100	3,075,048
1944													
1945													
1935-39 average	121,684	126,615	159,850	189,573	251,980	261,533	212,470	176,189	153,343	137,109	106,829	114,824	2,011,999

1/ Estimated

Source: 1935-1940 - Agricultural Statistics, 1942. United States Department of Agriculture
 1941 - Production by States of All Manufactured Dairy Products, 1941. Bureau of Agricultural Economics, January 1943
 1942 - Production of Manufactured Dairy Products, 1942. Bureau of Agricultural Economics, February 1944
 1943 - Monthly Evaporated, Condensed, and Dried Milk Reports. Bureau of Agricultural Economics

Table 12 - Dried whole milk and nonfat dry milk solids
for human consumption: Production, by States,
1942

State	: Dried : whole milk	: Nonfat dry : milk solids	:	State	: Dried : whole milk	: Nonfat dry : milk solids
	<u>1,000 lbs.</u>	<u>1,000 lbs.</u>	:		<u>1,000 lbs.</u>	<u>1,000 lbs.</u>
Maine	-	309	:	Kentucky	-	1,520
New Hampshire	-	-	:	Tennessee	39	2,844
Vermont	-	13,030	:	Alabama	-	-
Massachusetts	-	-	:	Mississippi	-	795
Rhode Island	-	-	:	Arkansas	-	-
Connecticut	-	76	:	Louisiana	-	1
			:	Oklahoma	-	325
New York	15,423	78,028	:	Texas	-	2,405
New Jersey	-	-	:			
Pennsylvania	1,122	19,603	:	Montana	-	-
			:	Idaho	-	8,246
Ohio	9,189	19,655	:	Wyoming	-	784
Indiana	161	18,584	:	Colorado	-	110
Illinois	8	2,535	:	New Mexico	-	-
Michigan	5,248	35,742	:	Arizona	-	306
Wisconsin	21,325	176,569	:	Utah	141	5,977
			:	Nevada	-	-
Minnesota	-	68,066	:			
Iowa	-	1,169	:	Washington	8	11,412
Missouri	164	17,467	:	Oregon	63	7,842
North Dakota	-	-	:	California	9,276	59,285
South Dakota	-	192	:			
Nebraska	-	4,454	:			
Kansas	-	5,819	:			
Delaware	-	-	:			
Maryland	-	1,832	:	UNITED STATES	62,167	565,414
Virginia	-	414	:			
West Virginia	-	18	:			
North Carolina	-	-	:			
South Carolina	-	-	:			
Georgia	-	-	:			
Florida	-	-	:			

Source: Production of Manufactured Dairy Products, 1942. Bureau of Agricultural Economics, February, 1944

Table 13 - Creamery butter (including whey butter): Production in the Midwest Region
by States, in selected years

State	1942	1940	1935	1930	1925	1920
	In thousands of pounds					
Illinois	74,944	80,642	71,360	65,286	56,872	41,051
Indiana	60,300	70,650	73,935	63,249	54,362	39,223
Iowa	241,518	245,312	217,810	216,058	156,361	84,290
Michigan	77,402	95,766	77,439	65,926	70,729	45,404
Minnesota	314,537	311,153	272,585	282,700	245,669	120,297
Missouri	75,359	82,024	87,438	77,939	55,953	35,228
Nebraska	90,665	83,327	76,400	85,623	83,930	56,661
North Dakota	66,675	58,416	39,726	41,032	31,500	13,419
Ohio	72,265	80,384	82,640	78,972	77,566	65,594
South Dakota	45,525	43,759	36,122	40,406	29,193	14,071
Wisconsin	161,472	183,103	159,908	173,411	161,369	97,355
MIDWEST REGION	1,280,662	1,334,536	1,195,363	1,190,602	1,023,504	612,593
UNITED STATES	1,764,054	1,836,826	1,632,380	1,597,747	1,361,526	863,577

Source: 1920, 1925 - Yearbook, United States Department of Agriculture, 1926
1930, 1935 - Production of Manufactured Dairy Products, 1939, and Statistics of Dairy
Production and Prices, Sales and Stocks of Dairy Products, 1939-1940.
Agricultural Marketing Service, June, 1941
1940 - Production by States of All Manufactured Dairy Products, 1940. Bureau of
Agricultural Economics, June, 1942
1942 - Production of Manufactured Dairy Products, 1942. Bureau of Agricultural
Economics, February, 1944

Table 14 - Malted milk powder: Production in the United States,
1916-1942

<u>In thousands of pounds</u>					
1916	.....	11,654	1931	.....	19,197
1917	.....	13,852	1932	.....	13,215
1918	.....	15,623	1933	.....	12,430
1919	.....	17,436	1934	.....	13,569
1920	.....	19,715	1935	.....	15,485
1921	.....	15,652	1936	.....	18,495
1922	.....	13,659	1937	.....	19,785
1923	.....	15,331	1938	.....	15,394
1924	.....	15,889	1939	.....	19,744
1925	.....	18,050	1940	.....	20,021
1926	.....	20,673	1941	.....	23,242
1927	.....	22,116	1942	.....	34,679
1928	.....	21,128	1943	.....
1929	.....	22,850	1944	.....
1930	.....	22,691	1945	.....

Source: 1916-1919 - Bureau of Agricultural Economics, quoted
in Wisconsin Dairying, Bulletin No. 200,
Wisconsin Crop Reporting Service, April,
1939
1920-1932 - Production and Consumption of Manufactured
Dairy Products, Technical Bulletin No. 722,
United States Department of Agriculture,
April, 1940
1933-1942 - Production of Manufactured Dairy Products,
1942. Bureau of Agricultural Economics,
February 1944

Table 15 - Dried buttermilk: Production in the United States
1916-1943

<u>In thousands of pounds</u>					
1916	.....	342	1931	.....	50,535
1917	.....	2,575	1932	.....	48,712
1918	.....	4,951	1933	.....	53,260
1919	.....	5,279	1934	.....	53,636
1920	.....	5,704	1935	.....	49,823
1921	.....	7,708	1936	.....	50,781
1922	.....	9,007	1937	.....	53,141
1923	.....	13,032	1938	.....	63,910
1924	.....	18,058	1939	.....	62,187
1925	.....	20,246	1940	.....	67,931
1926	.....	31,378	1941	.....	75,614
1927	.....	38,435	1942	.....	69,637
1928	.....	45,502	1943	.....	^{1/} 60,818
1929	.....	54,215	1944	.....
1930	.....	64,601	1945	.....

^{1/} Estimated

Source: 1916-1919 - Bureau of Agricultural Economics, quoted
in Wisconsin Dairying, Bulletin No. 200,
Wisconsin Crop Reporting Service, April,
1939
1920-1932 - Production and Consumption of Manufactured
Dairy Products, Technical Bulletin No.
722, United States Department of Agricul-
ture, April 1940
1933-1942 - Production of Manufactured Dairy Products,
1942. Bureau of Agricultural Economics,
February 1944
1943 - Monthly Evaporated, Condensed, and Dried
Milk Reports. Bureau of Agricultural
Economics

Table 16 - Nonfat dry milk solids for human food: average manufacturers' selling price f.o.b. factory by months, United States, 1935-1943; Average 1935-39

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Cents per pound													
1935	6.20	6.31	6.42	6.70	6.68	6.73	6.68	6.64	6.58	6.67	6.94	7.26	6.65
1936	7.73	7.84	8.08	8.23	8.36	8.89	8.63	8.78	9.40	9.56	9.62	9.61	8.73
1937	9.61	9.02	8.38	7.98	7.51	7.20	6.98	7.02	7.01	6.97	6.99	7.10	7.65
1938	6.96	6.65	5.98	5.67	5.24	5.05	4.90	5.10	4.98	4.93	5.02	5.14	5.47
1939	5.14	5.03	4.97	4.70	4.81	5.09	5.55	6.04	6.73	7.59	8.50	9.34	6.12
1940	8.78	7.48	6.45	5.75	5.90	6.07	6.72	7.05	7.19	6.91	7.16	6.95	6.87
1941	7.06	6.78	6.68	7.02	7.15	7.74	8.48	9.33	10.65	11.85	12.43	12.77	8.90
1942	13.13	13.06	12.79	12.69	12.57	12.63	12.69	12.87	13.11	13.26	13.16	13.37	12.94
1943	13.65	13.72	13.82	13.87	13.81	13.94	13.70	13.79	13.79	13.78	14.02	13.85	13.81
1944													
1945													
1935-39 average	7.13	6.97	6.77	6.66	6.52	6.59	6.55	6.72	6.94	7.14	7.41	7.69	6.92

Source: 1935-1942 - Farm Production, Disposition, and Income from Milk, 1941-42 and Miscellaneous Dairy Statistics, 1942. Bureau of Agricultural Economics, April 1943
 1943 - Monthly Dairy Situation. Bureau of Agricultural Economics

Table 17 - Dried whole milk: Average manufacturers' selling price, by months, United States, 1935-1943; Average 1935-39

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Cents per pound													
1935	15.22	15.71	15.99	16.49	16.29	16.31	16.09	14.93	15.17	14.98	15.43	15.70	15.69
1936	17.05	17.19	17.19	17.34	17.21	16.53	17.37	17.89	19.13	20.55	20.78	20.49	18.23
1937	19.70	19.12	17.62	17.31	17.25	17.04	16.88	16.92	18.16	18.27	18.67	18.84	17.98
1938	19.66	18.21	16.89	16.35	15.99	15.33	14.38	13.40	14.07	14.01	14.25	14.30	15.57
1939	14.65	14.61	14.47	14.01	13.32	13.82	13.65	14.44	15.45	16.66	18.12	17.98	15.10
1940	18.05	17.88	16.45	15.10	15.09	15.51	14.78	15.82	15.71	16.26	15.84	16.00	16.04
1941	16.86	17.48	16.71	17.15	17.93	18.08	19.72	20.31	22.18	24.37	23.32	24.18	19.86
1942	24.50	24.98	25.22	22.92	24.68	24.44	24.67	25.58	25.93	29.82	28.58	30.66	26.00
1943	31.10	33.55	32.28	32.71	32.63	32.91	31.66	33.54	33.51	32.77	33.08	33.35	32.76
1944													
1945													
1935-39 average	17.26	16.97	16.43	16.30	16.01	15.81	15.67	15.52	16.40	16.89	17.45	17.46	16.51

Source: 1935-1942 - Farm Production, Disposition, and Income from Milk, 1941-42 and Miscellaneous Dairy Statistics, 1942. Bureau of Agricultural Economics, April, 1943
 1943 - Monthly Dairy Situation. Bureau of Agricultural Economics

Table 18 - Casein, domestic: Average wholesale price, by months, New York, 1935-43; average 1935-39 1/

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Cents per pound													
1935	11.4	12.2	13.3	13.1	12.5	12.2	11.2	11.3	11.9	13.0	15.1	15.8	12.8
1936	15.8	15.4	15.2	15.4	15.2	15.6	16.5	17.6	18.0	17.5	17.5	19.0	16.6
1937	20.0	19.4	17.9	15.5	14.2	14.0	14.0	14.0	14.0	13.8	13.2	12.1	15.2
1938	11.0	9.9	9.1	7.6	7.3	7.8	8.5	10.3	10.2	9.3	8.6	9.0	9.0
1939	9.2	9.0	8.4	8.1	8.0	9.2	10.6	12.5	17.1	20.5	18.9	17.4	12.4
1940	15.1	13.2	11.2	10.5	12.6	14.0	14.2	14.0	12.9	12.6	13.3	14.0	13.1
1941	13.6	12.9	12.9	14.9	18.5	21.5	22.8	25.2	29.0	29.0	30.0	31.3	21.8
1942	30.4	28.1	23.4	21.5	20.0	16.3	14.6	17.1	18.9	20.1	20.0	20.0	20.9
1943	20.0	20.0	20.0	19.9	21.0	22.5	24.0	24.0	24.0	24.0	24.0	24.0	<u>2/</u>
1944													
1945													
1935-39 average	13.5	13.2	12.8	11.9	11.4	11.8	12.2	13.1	14.2	14.8	14.7	14.7	13.2

1/ 1935-1941 prices quoted for 80-100 mesh domestic casein; January, 1942 - March, 1943 prices quoted for 20-30 mesh domestic casein; and April, 1943 - December, 1943 prices quoted for domestic casein, acid precipitate.

2/ No average given because of change in the basis for quoting prices, effective April 9, 1943

Source: 1935-1941 - Agricultural Statistics, 1942. United States Department of Agriculture
1942-1943 - Monthly Dairy Situation. Bureau of Agricultural Economics

Table 19 - Butter, 92-score creamery: Wholesale price, by months, Chicago, 1935-43; Average 1935-39

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Cents per pound													
1935	32.6	35.0	30.8	32.8	26.0	23.5	23.6	24.4	25.4	27.2	31.5	33.1	28.8
1936	33.6	35.6	31.2	29.7	26.3	28.9	33.4	34.9	33.9	31.4	32.6	33.1	32.0
1937	33.0	33.4	35.0	31.2	30.3	30.0	30.7	32.0	34.1	34.9	37.0	37.3	33.2
1938	32.6	30.1	29.3	26.9	25.6	25.3	25.4	25.5	25.5	25.5	26.5	27.4	27.1
1939	25.5	25.5	23.7	22.0	22.8	23.6	23.2	23.5	27.4	28.4	29.5	29.5	25.4
1940	30.8	29.0	28.0	27.1	26.4	26.3	26.5	27.0	27.6	29.6	32.4	34.2	38.7
1941	30.1	30.1	30.8	32.5	34.7	35.4	34.3	35.0	36.6	35.2	35.8	34.6	33.8
1942	35.2	34.5	34.5	37.2	37.3	36.3	37.6	40.9	43.2	45.8	45.8	45.8	39.5
1943 ^{1/}	46.6	47.0	47.8	46.9	46.8	2/42.7	2/41.8	2/41.8	2/41.8	2/41.8	2/41.6	2/41.5	44.0
1944													
1945													
1935-39 average	31.5	31.9	30.0	28.5	26.2	26.3	27.3	28.1	29.3	29.5	31.4	32.1	29.3

^{1/} The method of quoting prices was changed effective December 30, 1942. The ceiling price comparable to quotations for earlier months was 46 cents at Chicago prior to June 4, 1943. The current comparable ceiling price is 41 cents. Variations in actual prices around these levels are due to changes in methods of sale as a result of amendments to Maximum Price Regulation 289.

^{2/} Does not include a subsidy of 5 cents per pound paid to manufacturers effective June 1, 1943.

Source: 1935-1941 - Agricultural Statistics, 1942. United States Department of Agriculture.
1942-1943 - Monthly Dairy Situation. Bureau of Agricultural Economics

Table 20 - Cheese, American Twins or Cheddars: Wholesale price on the Wisconsin Cheese Exchange, by months, 1935-43; Average 1935-39

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Cents per pound													
1935	14.1	15.7	14.8	14.7	13.5	12.3	12.7	13.9	14.1	14.2	15.1	17.0	14.3
1936	16.1	14.2	13.9	13.0	12.8	14.2	16.6	17.6	17.3	16.4	16.0	16.0	15.3
1937	16.0	16.0	16.0	14.8	14.5	14.5	14.6	15.7	16.6	17.4	17.5	17.0	15.9
1938	15.6	14.7	13.9	12.7	12.4	11.8	12.0	10.9	10.7	12.0	11.4	12.8	12.6
1939	11.8	11.7	11.4	11.2	11.7	12.6	12.0	12.4	14.2	15.0	15.0	15.0	12.8
1940	15.4	15.1	13.5	13.1	13.0	13.1	13.6	13.5	13.6	14.8	15.9	16.7	14.3
1941	15.6	14.8	14.7	16.5	17.8	18.4	20.5	21.6	22.9	23.2	23.2	23.2	19.4
1942	23.2	22.2	20.8	20.2	20.2	20.2	20.5	21.0	21.7	23.2	23.2	<u>1</u> /23.2	21.6
1943	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2
1944													
1945													
1935-39 Average	14.7	14.5	14.0	13.3	13.0	13.1	13.6	14.1	14.6	15.0	15.0	15.6	14.2

1/ Does not include a subsidy of 3 3/4 cents per pound paid to manufacturers, effective December 1, 1942

Source: 1935-1941 - Agricultural Statistics, 1942. United States Department of Agriculture
1942-1943 - Monthly Dairy Situation. Bureau of Agricultural Economics

Table 21 - Milk, evaporated, unsweetened: Average manufacturers' selling price of 48 14 $\frac{1}{2}$ -ounce cans, f.o.b. factory, by months, 1935-43; Average 1935-39

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
	Cents per case												
1935	2.67	2.83	2.82	2.83	2.83	2.80	2.62	2.58	2.59	2.59	2.73	2.91	2.73
1936	2.93	2.93	2.91	2.96	2.96	2.95	3.17	3.20	3.19	3.20	3.15	3.12	3.06
1937	3.11	2.99	2.96	2.98	2.97	2.97	3.01	3.06	3.06	3.07	3.07	3.07	3.03
1938	3.06	3.06	2.99	2.85	2.82	2.80	2.77	2.71	2.70	2.68	2.68	2.69	2.82
1939	2.70	2.69	2.68	2.67	2.68	2.67	2.68	2.68	2.79	2.89	2.93	2.94	2.75
1940	2.93	2.91	2.90	2.82	2.77	2.82	2.85	2.86	2.86	2.85	2.91	2.98	2.87
1941	2.96	2.95	2.95	3.04	3.13	3.29	3.42	3.56	3.65	3.67	3.67	3.67	3.33
1942	3.67	3.64	3.62	3.55	3.52	3.49	3.49	3.50	3.66	3.75	3.73	3.85	3.62
1943	4.15	4.14	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15
1944													
1945													
1935-39 average	2.89	2.90	2.87	2.86	2.85	2.84	2.85	2.85	2.87	2.89	2.91	2.95	2.88

Source: 1935-1941 - Agricultural Statistics, 1942. United States Department of Agriculture
1942-1943 - Monthly Dairy Situation. Bureau of Agricultural Economics

Appendix Table 22 - Illinois: Milk Produced by All Cows on Farms
and Sales of Butterfat from Herds of Four or More Cows
per Square Mile, by Counties, 1939

County	: Milk pro- : Butterfat :		County	: Milk pro- : Butterfat :	
	: duced per : sales per :			: duced per : sales per :	
	:square mile:square mile:			:square mile:square mile:	
	Gallons	Pounds		Gallons	Pounds
Adams	7,403	828	Lee	13,340	465
Alexander	2,364	179	Livingston	8,071	952
Bond	18,806	83	Logan	6,298	773
Boone	44,076	163	McDonough	7,440	1,067
Brown	5,776	897	McHenry	57,979	117
Bureau	8,910	953	McLean	8,323	823
Calhoun	3,174	233	Macon	7,890	730
Carroll	13,906	976	Macoupin	8,420	494
Cass	4,216	386	Madison	16,166	153
Champaign	6,698	635	Marion	5,506	611
Christian	7,096	786	Marshall	7,050	870
Clark	5,465	474	Mason	3,702	460
Clay	4,024	440	Massac	4,987	597
Clinton	14,464	107	Menard	5,362	562
Coles	6,885	507	Mercer	7,056	1,142
Cook	11,331	65	Monroe	5,664	298
Crawford	5,033	364	Montgomery	10,205	404
Cumberland	7,431	743	Morgan	5,942	610
De Kalb	15,207	336	Moultrie	8,715	705
De Witt	6,852	944	Ogle	13,569	546
Douglas	6,228	694	Peoria	7,953	841
Du Page	22,202	94	Perry	5,322	771
Edgar	5,758	641	Piatt	5,622	731
Edwards	4,623	576	Pike	4,489	477
Effingham	10,658	850	Pope	2,759	226
Fayette	7,306	717	Pulaski	4,557	391
Ford	6,336	963	Putnam	6,962	700
Franklin	4,358	232	Randolph	7,167	524
Fulton	5,741	857	Richland	4,956	655
Gallatin	2,845	145	Rock Island	11,591	1,070
Greene	6,672	464	St. Clair	8,277	209
Grundy	7,876	647	Saline	4,294	238
Hamilton	4,042	270	Sangamon	6,385	411
Hancock	7,451	1,173	Schuyler	5,532	945
Hardin	2,636	189	Scott	3,755	363
Henderson	4,928	793	Shelby	9,061	941
Henry	8,744	1,277	Stark	7,192	992
Iroquois	7,829	1,056	Stephenson	33,114	682
Jackson	5,918	768	Tazewell	8,872	717
Jasper	5,823	783	Union	4,815	582
Jefferson	5,661	680	Vermilion	6,736	661
Jersey	6,736	461	Wabash	5,129	525
Jo Daviess	17,099	2,182	Warren	6,975	1,013
Johnson	4,202	504	Washington	9,092	245
Kane	40,114	81	Wayne	3,745	323
Kankakee	10,921	463	White	3,891	425
Kendall	10,393	332	Whiteside	17,882	520
Knox	7,551	1,115	Will	12,724	251
Lake	24,542	212	Williamson	4,392	313
La Salle	8,049	645	Winnebago	23,114	363
Lawrence	3,855	463	Woodford	7,968	742

Computed from data presented in Census of Agriculture, 1940, Cows Milked and Dairy Products.

Appendix Table 23 - Indiana: Milk Produced by All Cows on Farms
and Sales of Butterfat from Herds of Four or More Cows
per Square Mile, by Counties, 1939

County	: Milk pro- : Butterfat :		County	: Milk pro- : Butterfat :	
	: duced per : sales per :			: duced per : sales per :	
	:square mile:	:square mile:		:square mile:	:square mile:
	Gallons	Pounds		Gallons	Pounds
Adams	16,825	1,179	Lawrence	4,641	405
Allen	12,385	1,053	Madison	12,943	712
Bartholomew	7,203	1,024	Marion	11,300	246
Benton	5,441	504	Marshall	18,019	1,539
Blackford	11,132	1,200	Martin	2,857	309
Boone	12,380	157	Miami	12,218	803
Brown	2,290	210	Monroe	5,155	257
Carroll	8,875	740	Montgomery	8,319	367
Cass	11,254	1,350	Morgan	7,125	236
Clark	9,085	1,086	Newton	6,310	527
Clay	7,641	775	Noble	15,370	2,808
Clinton	9,205	500	Ohio	14,347	1,859
Crawford	3,720	382	Orange	5,434	579
Daviess	6,529	616	Owen	3,997	403
Dearborn	9,919	1,326	Parke	6,463	490
Decatur	7,274	910	Perry	3,591	389
De Kalb	16,000	2,052	Pike	3,194	247
Delaware	14,552	797	Porter	15,809	354
Dubois	4,454	432	Posey	4,545	176
Elkhart	20,810	2,240	Pulaski	10,610	1,375
Fayette	7,418	571	Putnam	5,832	377
Floyd	10,803	890	Randolph	14,958	1,370
Fountain	8,015	726	Ripley	8,051	1,217
Franklin	8,820	905	Rush	7,385	537
Fulton	15,178	1,740	St. Joseph	14,582	410
Gibson	4,648	254	Scott	5,122	585
Grant	12,593	1,050	Shelby	12,239	565
Greene	4,690	358	Spencer	5,597	684
Hamilton	14,552	138	Starke	7,901	462
Hancock	11,719	388	Steuben	15,304	1,576
Harrison	6,726	942	Sullivan	5,026	156
Hendricks	13,528	207	Switzerland	12,761	1,442
Henry	12,759	730	Tippecanoe	6,827	413
Howard	13,014	612	Tipton	9,571	524
Huntington	16,159	1,771	Union	7,300	721
Jackson	4,401	421	Vanderburgh	7,533	167
Jasper	7,918	958	Vermillion	6,671	398
Jay	11,502	758	Vigo	6,330	297
Jefferson	7,125	688	Wabash	14,384	1,354
Jennings	4,761	722	Warren	5,007	580
Johnson	12,773	396	Warrick	6,055	335
Knox	6,022	384	Washington	6,985	496
Kosciusko	14,793	1,791	Wayne	12,540	894
Lagrange	18,259	3,625	Wells	16,353	973
Lake	12,193	125	White	7,377	1,007
La Porte	11,463	466	Whitley	14,759	2,323

Computed from data presented in Census of Agriculture, 1940, Cows Milked and Dairy Products.

Appendix Table 24 - Iowa: Milk Produced by All Cows on Farms
and Sales of Butterfat from Herds of Four or More Cows
per Square Mile, by Counties, 1939

County	Milk pro- duced per :square mile:	Butterfat sales per :square mile:	County	Milk pro- duced per :square mile:	Butterfat sales per :square mile:
	Gallons	Pounds		Gallons	Pounds
Adair	9,164	2,109	Jefferson	7,598	1,652
Adams	8,085	1,778	Johnson	10,402	1,639
Allamakee	17,253	3,726	Jones	18,615	4,768
Appanoose	6,056	994	Keokuk	9,374	2,083
Audubon	10,086	2,519	Kossuth	11,974	3,417
Benton	10,989	2,559	Lee	9,512	1,454
Black Hawk	20,477	5,023	Linn	15,951	2,874
Boone	11,080	2,110	Louisa	5,869	1,082
Bremer	29,553	7,120	Lucas	7,252	1,354
Buchanan	17,898	4,206	Lyon	12,282	3,276
Buena Vista	10,669	2,480	Madison	6,852	1,301
Butler	17,257	4,025	Mahaska	12,036	2,345
Calhoun	9,264	1,980	Marion	9,540	1,684
Carroll	11,302	2,413	Marshall	11,730	2,559
Cass	8,199	1,780	Mills	8,178	1,555
Cedar	10,847	2,478	Mitchell	16,104	3,992
Cerro Gordo	15,532	3,531	Monona	6,259	918
Cherokee	7,615	1,538	Monroe	7,224	1,107
Chickasaw	18,285	4,757	Montgomery	7,678	1,200
Clarke	6,097	1,249	Muscatine	12,203	2,471
Clay	9,694	2,466	O'Brien	11,414	2,990
Clayton	22,192	6,198	Osceola	12,958	3,308
Clinton	10,980	2,233	Page	8,679	1,309
Crawford	9,097	1,782	Palo Alto	11,803	3,182
Dallas	10,798	1,725	Plymouth	7,469	1,292
Davis	6,599	1,366	Pocahontas	9,107	2,180
Decatur	6,470	1,316	Polk	13,912	1,156
Delaware	23,008	6,653	Pottawattamie	8,732	1,476
Des Moines	9,845	1,360	Poweshiek	10,095	1,978
Dickinson	11,623	2,948	Ringgold	6,848	1,281
Dubuque	19,637	4,504	Sac	8,848	2,018
Emmet	12,679	3,212	Scott	21,982	2,273
Fayette	20,975	5,690	Shelby	7,778	1,677
Floyd	12,949	3,109	Sioux	17,076	4,507
Franklin	14,242	3,843	Story	12,902	2,736
Fremont	5,881	689	Tama	10,115	2,184
Greene	8,845	1,954	Taylor	8,362	1,545
Grundy	13,299	3,358	Union	8,238	1,587
Guthrie	8,768	1,909	Van Buren	7,948	1,828
Hamilton	9,883	2,246	Wapello	10,309	1,507
Hancock	13,838	3,658	Warren	9,147	1,106
Hardin	13,079	3,311	Washington	9,259	1,776
Harrison	7,599	1,364	Wayne	6,307	1,375
Henry	8,907	1,704	Webster	9,100	1,552
Howard	19,391	4,543	Winnebago	18,706	5,322
Humboldt	11,096	2,602	Winneshek	22,229	5,264
Ida	7,497	1,500	Woodbury	7,580	857
Iowa	10,626	2,308	Worth	18,497	4,830
Jackson	11,973	3,118	Wright	10,198	2,280
Jasper	10,406	2,068			

Computed from data presented in Census of Agriculture, 1940, Cows Milked and Dairy Products.

Appendix Table 25 - Michigan: Milk Produced by All Cows on Farms
and Sales of Butterfat from Herds of Four or More Cows
per Square Mile, by Counties, 1939

County	: Milk pro- : Butterfat. :		County	: Milk pro- : Butterfat :	
	: duced per : sales per :			: duced per : sales per :	
	:square mile:square mile:			:square mile:square mile:	
	<u>Gallons</u>	<u>Pounds</u>		<u>Gallons</u>	<u>Pounds</u>
Alcona	3,413	662	Lake	2,785	687
Alger	1,762	216	Lapeer	20,701	964
Allegan	17,737	1,138	Leelanau	6,529	953
Alpena	5,834	1,077	Lenawee	20,402	411
Antrim	6,104	1,470	Livingston	14,057	325
Arenac	10,666	1,123	Luce	571	71
Baraga	2,115	104	Mackinac	1,375	157
Barry	14,819	2,099	Macomb	22,973	201
Bay	17,595	1,074	Manistee	4,701	753
Benzie	3,489	392	Marquette	1,134	97
Berrien	11,115	518	Mason	12,016	2,434
Branch	17,655	1,945	Mecosta	11,844	3,093
Calhoun	13,556	1,593	Menominee	8,022	80
Cass	11,438	2,263	Midland	9,111	1,327
Charlevoix	6,809	1,353	Missaukee	8,666	2,233
Cheboygan	3,819	649	Monroe	13,994	277
Chippewa	2,493	363	Montcalm	14,317	1,580
Clare	5,369	1,061	Montmorency	1,898	301
Clinton	17,206	1,440	Muskegon	9,539	264
Crawford	418	52	Newaygo	8,374	1,600
Delta	4,129	242	Oakland	12,062	212
Dickinson	2,546	222	Oceana	9,319	2,000
Eaton	18,069	1,278	Ogemaw	5,315	971
Emmet	5,762	961	Ontonagon	2,271	204
Genesee	16,213	823	Osceola	11,047	2,317
Gladwin	8,940	2,047	Oscoda	1,364	235
Gogebic	1,271	39	Otsego	2,877	588
Grand Traverse	7,321	1,455	Ottawa	22,770	1,645
Gratiot	17,191	2,481	Presque Isle	4,283	798
Hillsdale	20,501	2,317	Roscommon	778	123
Houghton	4,473	216	Saginaw	16,666	1,119
Huron	17,957	1,432	St. Clair	18,953	585
Ingham	17,915	606	St. Joseph	11,637	2,154
Ionia	17,877	2,716	Sanilac	21,918	1,446
Iosco	3,994	726	Schoolcraft	527	55
Iron	1,698	280	Shiawassee	19,579	966
Isabella	16,850	2,620	Tuscola	17,027	895
Jackson	13,465	1,044	Van Buren	11,903	1,198
Kalamazoo	12,583	969	Washtenaw	16,755	393
Kalkaska	2,684	632	Wayne	8,560	31
Kent	18,001	992	Wexford	5,543	1,222
Keweenaw	281	10			

Computed from data presented in Census of Agriculture, 1940, Cows Milked and Dairy Products.

Appendix Table 26 - Minnesota: Milk Produced by All Cows on Farms
and Sales of Butterfat from Herds of Four or More Cows
per Square Mile, by Counties, 1939

County	: Milk pro- : Butterfat :		County	: Milk pro- : Butterfat :	
	: duced per : sales per :			: duced per : sales per :	
	:square mile:square mile:			:square mile:square mile:	
	<u>Gallons</u>	<u>Pounds</u>		<u>Gallons</u>	<u>Pounds</u>
Aitkin	4,889	1,314	Marshall	5,419	1,352
Anoka	17,441	997	Martin	15,110	4,183
Becker	9,081	2,412	Meeker	23,620	7,103
Beltrami	2,384	535	Mille Lacs	17,527	5,011
Benton	21,574	6,078	Morrison	13,252	3,848
Big Stone	7,156	1,622	Mower	18,260	4,826
Blue Earth	18,105	4,949	Murray	10,901	2,737
Brown	15,528	4,429	Nicollet	20,672	5,816
Carlton	9,317	1,748	Nobles	11,469	3,042
Carver	47,684	8,873	Norman	8,607	2,212
Cass	3,361	806	Olmsted	24,013	4,435
Chippewa	10,779	2,650	Otter Tail	17,138	4,978
Chisago	27,518	5,353	Pennington	8,422	2,229
Clay	6,893	1,402	Pine	10,734	2,620
Clearwater	5,534	1,400	Pipestone	12,262	3,077
Cook	135	12	Polk	8,204	1,881
Cottonwood	10,970	2,906	Pope	13,020	3,500
Crow Wing	5,526	1,165	Ramsey	17,635	347
Dakota	24,809	1,169	Red Lake	9,229	2,210
Dodge	29,843	4,326	Redwood	10,292	2,690
Douglas	20,720	6,158	Renville	12,732	3,433
Faribault	15,373	4,219	Rice	32,818	5,807
Fillmore	16,446	4,319	Rock	11,217	2,890
Freeborn	27,873	8,322	Roseau	4,229	1,111
Goodhue	28,142	5,056	St. Louis	2,405	269
Grant	10,975	3,083	Scott	29,301	3,976
Hennepin	33,193	775	Sherburne	12,029	2,180
Houston	16,428	4,189	Sibley	23,867	6,864
Hubbard	4,121	1,013	Stearns	20,973	5,826
Isanti	16,232	3,206	Steele	33,805	10,498
Itasca	2,274	432	Stevens	9,926	2,388
Jackson	12,300	3,157	Swift	8,874	2,268
Kanabec	14,385	3,998	Todd	21,795	6,272
Kandiyohi	14,612	4,092	Traverse	6,618	1,585
Kittson	4,678	1,133	Wabasha	18,890	5,234
Koochiching	866	147	Wadena	12,733	3,788
Lac qui Parle	8,400	2,130	Waseca	23,730	6,897
Lake	226	15	Washington	29,345	2,073
Lake of the Woods	1,262	263	Watonwan	15,724	4,597
Le Sueur	18,751	5,368	Wilkin	6,728	1,642
Lincoln	11,124	3,043	Winona	19,522	5,290
Lyon	9,730	2,245	Wright	29,874	7,413
McLeod	35,098	8,240	Yellow Medicine	8,925	2,311
Mahnomen	5,917	1,671			

Computed from data presented in Census of Agriculture, 1940, Cows Milked and Dairy Products.

Appendix Table 27 - Ohio: Milk Produced by All Cows on Farms
and Sales of Butterfat from Herds of Four or More Cows
per Square Mile, by Counties, 1939

County	: Milk pro- : Butterfat :		County	: Milk pro- : Butterfat :	
	: duced per : sales per :			: duced per : sales per :	
	:square mile:square mile:			:square mile:square mile:	
	Gallons	Pounds		Gallons	Pounds
Adams	5,160	622	Licking	14,417	806
Allen	12,356	1,182	Logan	14,339	1,212
Ashland	13,499	1,032	Lorain	23,158	122
Ashtabula	21,411	192	Lucas	6,129	173
Athens	7,959	498	Madison	8,483	618
Auglaize	15,305	1,731	Mahoning	16,722	354
Belmont	13,642	908	Marion	11,375	713
Brown	7,947	815	Medina	23,684	335
Butler	16,191	538	Meigs	5,852	490
Carroll	9,409	453	Mercer	14,790	811
Champaign	17,169	904	Miami	17,727	1,152
Clark	17,003	1,089	Monroe	8,497	1,076
Clermont	12,385	748	Montgomery	15,578	563
Clinton	8,952	413	Morgan	6,662	624
Columbiana	15,986	404	Morrow	12,167	1,542
Coshocton	9,020	586	Muskingum	7,627	862
Crawford	11,688	1,666	Noble	8,051	1,303
Cuyahoga	4,142	17	Ottawa	10,804	213
Darke	17,834	1,086	Paulding	8,429	745
Defiance	11,810	764	Perry	6,880	669
Delaware	18,849	497	Pickaway	7,050	689
Erie	12,318	524	Pike	3,373	172
Fairfield	11,784	765	Portage	19,717	180
Fayette	5,442	334	Preble	13,295	1,162
Franklin	15,158	893	Putnam	10,933	1,024
Fulton	21,436	688	Richland	12,386	1,162
Gallia	6,264	365	Ross	4,871	262
Geauga	21,420	40	Sandusky	13,942	686
Greene	11,592	489	Scioto	5,621	178
Guernsey	8,097	984	Seneca	12,070	1,242
Hamilton	11,488	150	Shelby	14,656	1,797
Hancock	12,989	1,632	Stark	20,479	326
Hardin	11,015	888	Summit	11,826	54
Harrison	8,281	841	Trumbull	17,412	106
Henry	12,635	1,119	Tuscarawas	14,157	285
Highland	9,102	473	Union	18,941	763
Hocking	3,392	226	Van Wert	11,984	672
Holmes	19,036	930	Vinton	2,518	246
Huron	10,664	586	Warren	15,668	307
Jackson	3,994	300	Washington	6,913	724
Jefferson	7,480	289	Wayne	25,151	890
Knox	12,096	1,318	Williams	15,936	1,842
Lake	6,776	83	Wood	9,869	503
Lawrence	4,714	193	Wyandot	10,809	1,668

Computed from data presented in Census of Agriculture, 1940, Cows Milked and Dairy Products.

Appendix Table 28 - Wisconsin: Milk Produced by All Cows on Farms
and Sales of Butterfat from Herds of Four or More Cows
per Square Mile, by Counties, 1939

County	: Milk pro- : duced per : square mile:	: Butterfat : : sales per : : square mile:	County	: Milk pro- : duced per : square mile:	: Butterfat : : sales per : : square mile:
	<u>Gallons</u>	<u>Pounds</u>		<u>Gallons</u>	<u>Pounds</u>
Adams	5,166	1,182	Marathon	28,998	95
Ashland	3,920	220	Marinette	8,292	245
Barron	37,520	603	Marquette	8,970	2,365
Bayfield	3,998	566	Milwaukee	21,419	31
Brown	55,799	277	Monroe	24,803	5,676
Buffalo	20,214	5,725	Oconto	17,748	70
Burnett	7,664	2,088	Oneida	1,674	162
Calumet	60,307	68	Outagamie	52,784	94
Chippewa	29,417	95	Ozaukee	48,169	249
Clark	34,868	51	Pepin	20,497	5,771
Columbia	24,629	1,968	Pierce	28,579	6,236
Crawford	19,924	1,350	Polk	27,386	3,328
Dane	43,694	1,483	Portage	14,639	1,196
Dodge	56,663	269	Price	6,476	265
Door	26,757	73	Racine	43,091	198
Douglas	4,290	300	Richland	36,405	950
Dunn	28,261	3,009	Rock	38,407	360
Eau Claire	18,819	1,707	Rusk	14,525	70
Florence	2,933	400	St. Croix	31,823	5,088
Fond du Lac	52,077	2,854	Sauk	28,858	3,940
Forest	1,670	234	Sawyer	2,625	349
Grant	23,159	2,042	Shawano	25,131	53
Green	58,344	140	Sheboygan	63,502	66
Green Lake	26,046	5,486	Taylor	16,847	2,332
Iowa	30,867	887	Trempealeau	26,665	6,353
Iron	2,326	45	Vernon	32,846	5,216
Jackson	11,125	2,052	Vilas	803	91
Jefferson	51,410	656	Walworth	54,927	107
Juneau	12,184	3,121	Washburn	7,036	1,017
Kenosha	42,966	136	Washington	50,523	68
Kewaunee	54,682	44	Waukesha	54,244	124
La Crosse	28,367	6,676	Waupaca	34,724	944
Lafayette	31,884	299	Waushara	17,038	1,530
Langlade	10,563	27	Winnebago	47,220	1,515
Lincoln	10,911	342	Wood	24,176	121
Manitowoc	57,567	105			

Computed from data presented in Census of Agriculture, 1940, Cows Milked and Dairy Products.